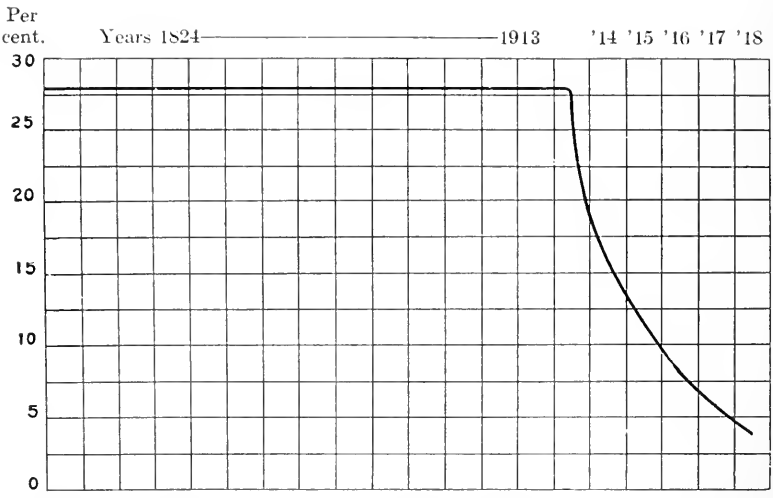

Recent Decrease in Deaths from Diabetes at Massachusetts General Hospital, 1824-1918. See Table 2, page 23.

A

DIABETIC MANUAL

FOR THE

MUTUAL USE OF DOCTOR AND PATIENT

BY

ELLIOTT P. JOSLIN, M.D.

ASSISTANT PROFESSOR OF MEDICINE, HARVARD MEDICAL SCHOOL; CONSULTING PHYSICIAN, BOSTON CITY HOSPITAL; COLLABORATOR TO THE NUTRITION LABORATORY OF THE CARNEGIE INSTITUTION OF WASHINGTON, IN BOSTON; FORMERLY LIEUTENANT-COLONEL, M. C., U. S. ARMY

Illustrated

SECOND EDITION, THOROUGHLY REVISED

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1919

TO

HELP MAKE THE HOME

SAFE FOR THE

DIABETIC

IS THE OBJECT OF

THIS BOOK.

PREFACE TO THE SECOND EDITION.

The first edition of this book was written just prior to the entrance of the writer into the army and was reprinted before his discharge. Though compiled under unfavorable conditions it evidently met a need. However, the treatment of diabetes is improving and to keep pace with the advance this edition has been prepared. The Manual has been thoroughly revised, condensed and simplified, with the renewed purpose to make it serve as a text-book for the physician to use in the education of his patients. The growing number is already too great to permit of adequate treatment without some such assistance. I still feel that for one diabetic patient who learns too much about the disease, there are unquestionably ninety-nine who know too little. Those of my patients who are the most intelligent and those who understand the disease the best live the longest.

There is no satisfaction in treating ignorant diabetics. The possibility exists of bringing the knowledge of each one up to such a point that he will not only coöperate, but be able to ask questions which are both stimulating and searching. In this way we physicians will be forced to forge ahead.

I wish the faithful laboratory workers in our medical schools could have the pleasure of watching a diabetic patient improve. They have done so much to help the diabetic and yet they miss the enjoyment of seeing what is being accomplished. It is from the scientific investigations

in laboratories that new discoveries for diabetics will come. Patients, and practising physicians as well, should realize their opportunity of helping themselves by fostering laboratory research upon diabetes.

To the many friends who have given suggestions, to that one rare friend who offered criticisms, to my assistant Dr. Albert A. Hornor and to my secretary, Miss Anna Holt, I am most grateful.

Elliott P. Joslin.

CONTENTS.

DIABETIC MANUAL.

CHAPTER I.

DIABETES.

Diabetes is a disease which has a peculiar fascination for all who come in contact with it. No malady to which human flesh is heir, in comparison with the number of individuals involved, has attracted as much attention. And while the riddle of diabetes is far from being solved, the studies made upon it have been of inestimable value in throwing light upon many of the intricate processes which are continually going on in the body and have also brought about improvement in the treatment of the disease itself. In diabetes the chemist always finds problems beguiling him by their apparent simplicity and tempting him on to their elucidation; and if one has a statistical bent, the lure of accumulating columns of figures, recording the results of many tests, will so engross the attention that, like the miser counting his gold, one will often find himself poring over them without appreciating their true significance. In diabetes the physician has an opportunity to observe such concrete results from a few words of careful advice upon diet to his patient as to compensate him for the time spent upon many needless ills and encourage him always to practice scientific rather than empirical medicine. And as for the patient, the first effects of treatment appear to him so magical that he can hardly believe them to be explained by the simple measures he has adopted. Indeed, with the slightest hint he is eager to attribute them to the most improbable sources.

It is perfectly true that diabetes is a chronic disease, but, unlike rheumatism and cancer, it is painless; unlike tuberculosis, it is clean and not contagious, and in contrast to many diseases of the skin, it is not unsightly. Moreover, it is susceptible to treatment, and the downward course of a patient can usually be promptly checked. Treatment, however, is by diet and not by drugs, and the patients who know the most, conditions being equal, can live the longest. There is no disease in which an understanding by the patient of the methods of treatment avails as much. Brains count. But knowledge alone will not save the diabetic. This is a disease which tests the character of the patient, and for success in withstanding it, in addition to wisdom, he must possess honesty, self-control and courage. Already 34 of my patients have lived longer than would have been expected of them had they been normal, healthy people. For the diabetic this is a demonstration and a challenge.

The underlying cause of diabetes is usually considered to be a derangement in one of the functions of the pancreas. This is a gland, in animals known as the sweetbread, which lies behind the stomach near the liver. It discharges into the bowel the most important digestive juice of any gland in the body, and this juice is capable of digesting all kinds of food. Strangely enough this digestive action of the pancreas remains undisturbed in diabetes. The fault with the pancreas in diabetes concerns that function of the gland which regulates the body's use of the sugar formed from the food. This function appears to reside in groups of cells distributed throughout the pancreas and called the "islands of Langerhans." When these cells have been found to be diseased a history of diabetes has been usually demonstrable. These groups of cells probably manufacture a special internal secretion which is discharged into the blood. Experimentally, with animals, it is easy to produce diabetes by simply removing a large portion of the pancreas, and the severity of the diabetes so produced is proportional to the amount of the gland removed. If the diabetic patient could secure a new pancreatic gland he would be cured.

As yet all attempts to treat diabetes successfully by feeding

patients the healthy pancreatic glands of animals, by the use of extracts made from the gland or by grafting portions of a healthy gland under the skin, have failed. Nevertheless, it is hoped that some measure of success will be achieved eventually along these lines.

Granted there is a natural tendency to diabetes in certain individuals, this develops into the actual disease most commonly when the body is overfed. Approximately 60 per cent. of a recent series of 100 diabetic cases showed obesity. The average number of pounds overweight for a group of 457 diabetic patients for different ages is shown in Table 1.

TABLE 1.—OVERWEIGHT USUALLY PRECEDES DIABETES.

Age in years.	Number of cases.	Average number of pounds overweight.
12 to 24	38	3
25 to 29	27	54
30 to 39	72	23
39 and over	320	37

Lack of exercise is, of course, a factor in producing the condition of overweight, and thus is an indirect cause of diabetes. Disuse of the muscles, however, is itself a direct factor, for it is largely in these that the sugar formed from the food is consumed. That man who gives up an active outdoor life and is promoted to an office chair by this change becomes a promising candidate for diabetes. If the overfeeding has been in the form of sugar, predisposition to diabetes is greater. There is real danger in the candy habit. It is possible that the recent increase in the quantity of sugar consumed per capita in the United States has increased our number of diabetics. Between 1800 and 1810 the average consumption of sugar by each individual in the United States was 11 pounds a year, but between 1910 and 1917 it was 73 pounds, and Mr. Hoover is credited in the daily papers for September, 1917, with showing this figure for 1916 to be 90 pounds.

No other condition rivals obesity in importance as a forerunner of diabetes, but a strenuous, mental life is probably of some significance. This appears reasonable, for it has been shown that medical students, after three-hour written

examinations upon which their promotion for a year depends, often show sugar in the urine immediately thereafter, and it may not be a chance coincidence that during one year three children were under my care for diabetes who had recently led their respective classes at school. Another illustration of this tendency is Case No. 1380, a child who came to the office showing 6.2 per cent. of sugar. She had skipped two classes at school, and the following summer had eaten even more than her habitually large amount of sweets and candy.

In the presence of an infectious disease, for example tonsillitis, an existing diabetes grows worse; but it is yet to be demonstrated that diabetes frequently occurs as the result of an infection.

Of my cases, only 21 per cent. show a history of diabetes in their families, *i. e.*, that the disease has been present in parents, brothers or sisters.

Hereditary cases are usually mild. With the avoidance of obesity and with moderation in the use of sweet food the children of diabetics may be no more liable to the disease than other children. Particularly should the urines of such individuals be carefully examined when conditions arise which would favor the development of diabetes.

It would be a great mistake to consider the diet alone of importance. Mental relaxation and physical exercise should be promoted. If we are to bring about a decrease of diabetes in the community it will be with measures such as these. Every agency which promotes health and physical development tends to prevent an outbreak of the diabetic tendency. "It is easier to keep well than to get well."

The disease sugar diabetes, usually known by its Latin name, "diabetes mellitus," is revealed when sugar is found in the urine. The development of the disease may be gradual or acute, and with or without symptoms. It is fortunate that the disease can be so readily discovered, for unlike many diseases whose beginnings can be detected only by specialists or disclosed by the help of elaborate and expensive methods, such as the Roentgen rays, diabetes can be easily and promptly recognized by any physician who will be on the watch for it

and will examine the urine of his patient for sugar. The subsequent behavior of the disease and the effect of treatment are also easily regulated by simple examinations, and herein the diabetic has a great advantage over many another patient.

The sugar in the urine of diabetic patients is derived from the food, and chiefly from that consumed within the preceding twenty-four hours. The effects of a meal begin to show within ten minutes by an increase of sugar in the blood or by the appearance of sugar in the urine. Most of the sugar in the urine comes from carbohydrate (sugar and starch), but in extremely severe cases as much as 60 per cent. of the protein (examples of which are lean of meat and fish, white of egg and curd of milk) in the diet may change to sugar. No sugar is formed from fat, but if a diabetic eats too much fat he utilizes the carbohydrate and protein of the diet less well.

Improvement in diabetes takes place when the urine is kept free from sugar. The annoying symptoms of the untreated diabetic then vanish. Under such conditions the power of the pancreas to assimilate carbohydrate is increased. Conversely, if the urine is not free from sugar the patient is generally only holding his own, or more likely is growing worse. Professor Naunyn, who for a generation was perhaps the leading specialist in diabetes, observed that even severe cases if treated early did well, whereas mild cases if neglected usually did poorly.

Examinations of the blood for sugar give valuable information in the treatment of diabetes. The sugar in the blood usually rises above normal before sugar in the urine appears. Consequently, if information can be learned about the blood sugar, one often anticipates the information which an examination of the urine alone would show. The knowledge about the blood sugar is still fragmentary, and it must be acknowledged that many cases of diabetes have lived comfortably without a single blood sugar estimation. However, analyses of the blood sugar now appear to be of much value.

In what follows an attempt will be made to show how to treat the disease, and since success in treatment is most easily

attained by the selection of a diet which will keep the urine sugar-free, detailed advice along dietetic lines will be given. The responsibility for maintaining this favorable state must rest in large measure upon the patient himself. He must learn what diet is best for him and must constantly control his condition by the examination of his urine. He is his own nurse, doctor's assistant and chemist. If he tries to be his own doctor he will come to grief. To acquire the requisite knowledge for this triple vocation requires diligent study, but the prize offered is worth while, for it is nothing less than life itself.

CHAPTER II.

THE RECENT IMPROVEMENT IN DIABETIC TREATMENT.

One often hears the remark that patients with diabetes live for years, with little inconvenience to themselves, even though strict rules of diet are neglected. This may be a consoling thought to some weak-willed patient, but if the average diabetic yields to such seductive advice the probability is overwhelming that he will later pay the penalty. Furthermore, such statements are not true. Their origin lies in the favorable course of the large number of mild cases of diabetes, but just as it is a serious blunder in war to disparage the strength of the enemy, so it is in diabetes.

Table 2.—The Recent Improvement in Diabetic Treatment as Shown by the Statistics of the Massachusetts General Hospital.

Period.	Number of cases.	Mortality during hospital stay. Number of deaths.	Per cent.
1824 to 1898	172	47	27
1898 to 1914	284	80	28
1914	51	8	16
1915	89	11	12
1916	103	8	8
1917	105	6	6
1918	108	4	4

How serious in the past diabetes has really been, and at the same time how much the methods of treatment have improved during the recent years, is best shown by the statistics for diabetes of the Massachusetts General Hospital. These statistics are incorporated in Table 2. No student of medicine, practitioner, patient or investigator can fail to be impressed by them or to gather hope for the future from this steady reduction in mortality. It is gratifying that

this advance has come through hard work and not through chance, and that multitudes of scientific men and women have shared in it. All will gladly acknowledge the important part which Dr. Frederick M. Allen, formerly of the Rockefeller Institute for Medical Research, has taken in bringing this about.

These figures are far more valuable than those of a single individual. Confirmatory of the Massachusetts General Hospital statistics, however, are those of my own cases treated at the Corey Hill Hospital and the New England Deaconess Hospital between January, 1913, and January, 1918, as shown in Table 3.

TABLE 3.—MORTALITY AMONG AUTHOR'S CASES TREATED AT THE COREY HILL AND NEW ENGLAND DEACONESS HOSPITALS, JANUARY, 1913, TO NOVEMBER, 1919.

Year.	Number of cases.	Mortality during hospital stay.	
		Number of deaths.	Per cent.
1913	43	4	9
1914	60	3	5
1915	109	6	6
1916	164	8	5
1917	181	4	2
1918[1]	23	0	0
1919[2]	105	2	2

The improvement may be attributed to (1) the introduction of newer methods of treatment inaugurated by Dr. Allen; (2) more accurate tests for the estimation of the severity of acid poisoning—that arch enemy of the diabetic; (3) the preliminary omission of fat prior to any change in diet; (4) the omission of alkalies.

What acute or chronic disease can show an advance in treatment comparable to that demonstrated in Tables 2 and 3 during the last three years?

The improvement in treatment which will accrue from examinations of sugar in the blood will appear later. In 1916, 28 cases were published, showing an average of 0.22 per cent. sugar in the blood upon admission to the hospital.

[1] February 6, 1918, to March 1, 1919, absent on duty, Medical Corps, U. S. Army.

[2] Resumed practice April 1, 1919; April 1, 1919 to November 1, 1919.

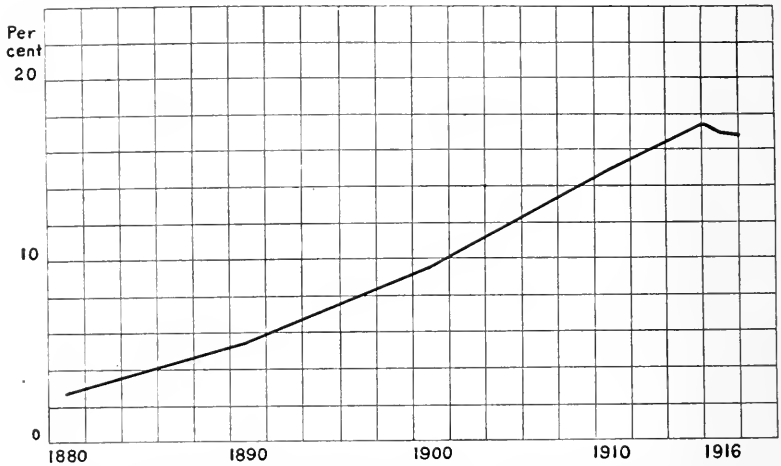
The normal quantity of sugar in the blood is 0.10 per cent. At that time the percentage of sugar in the blood at discharge was 0.20 per cent. In 1917, 64 cases were reported. The average blood sugar on admission was 0.24 per cent., upon discharge 0.19 per cent. During seven months of 1919 the figures for 93 patients are now available. They show, as compared with the above data, 0.20 per cent. on entrance and 0.14 per cent. upon discharge. Patients now leave the hospital in safer condition than ever before. This is due to the protection afforded by the knowledge gained through repeated blood sugar estimations.

The need of further improvement in the treatment of severe diabetes still exists. This fact must be courageously faced. The prevention of acid intoxication is an important victory yet to be won. This will be borne in mind in all that follows about treatment, but for a summary of the nature of acid poisoning, its cause and the measures now available to combat it, see page 108.

Hospital statistics demonstrate that the opportunity for further improvement in the treatment of diabetes lies not in the hospital but in the home. To this end a campaign must be aggressively waged. If the mortality can be reduced nearly to zero in the hospital, these same results ought to be attained outside of the hospital, for there is no reason why the methods which have made hospital treatment comparatively safe should not be employed in making treatment in the home safe. It is unreasonable to expect that the ultimate diabetic mortality in the home will be as low as that in the hospital, because of the shorter duration of stay in the latter, but the time has arrived when the accidental and avoidable deaths which have now been largely eliminated from the statistics of the best hospitals should also be eliminated from private practice. The secret of the success of hospital improvement lies in the close and continuous observation of the patient by the doctor. For success in home treatment, close and continuous observation of the patient by the doctor is just as essential. My assistant of several years ago, Dr. F. Gorham Brigham, has taken pains to bring this about in his systematic manner by having all

his diabetic patients report at stated intervals, sometimes long, sometimes short, for observation.

Two reasons have prevented doctors in the past from urging patients to return for treatment. Prior to 1914, before the time of striking improvement in diabetes existed, physicians feared that new suggestions might make a patient, apparently doing well, get worse, and it was considered safer to let well enough alone. In the second place physicians hesitated to ask patients to return for fear of being considered commercial. Today, with the more widespread knowledge concerning this disease, both on the part of the doctor and patient, these two objections will vanish.



The rising rate of deaths from diabetes per 100,000 between the years 1880 and 1917 in the registration area of the United States.

CHAPTER III.

QUESTIONS AND ANSWERS FOR DIABETIC PATIENTS.

Knowledge Essential for a Diabetic.—The treatment of a patient with diabetes lasts through life. All too often in recent years it has been felt that if the urine were rendered sugar-free by fasting, the treatment of the diabetic ended; in reality it has hardly begun. Treatment must therefore be adjusted to the condition of the patient, and should be so arranged that it can be continued for years not only without harm, but with as little annoyance or interference with the daily routine as is possible. Consequently, the patient must be taught the nature of his disease and how to conquer it.

In the following questions and answers an attempt is made to indicate the essential features of the knowledge desirable for a diabetic patient.

1. QUESTION. Why does the human body need food?

ANS. To furnish heat, repair waste, permit growth, and exercise.

2. QUESTION. How may the many varieties of food be simply classified?

ANS. Carbohydrate, protein and fat, also water and salts.

(*a*) QUESTION. Upon what does the nutritive value of food depend?

ANS. The quantity of carbohydrate, protein and fat which it contains.

(*b*) QUESTION. What is carbohydrate?

ANS. It occurs in many forms, but examples of it are sugar and starch. Cane sugar is the commonest sugar. A

pure form of starch is corn starch. Fruits are almost entirely water and sugar and vegetables are largely water and starch. Bananas, when green, contain nearly 20 per cent. starch, but when ripened this changes to sugar. Starchy foods during digestion in the body rapidly change to sugar, and consequently these two foods are nearly interchangeable. Potatoes are 20 per cent. starch. Bread is about 55 per cent. starch, and the flour out of which it is made, being drier than the bread, contains about 70 per cent. Oatmeal is two-thirds starch, but other cereals contain rather more. Milk contains 5 per cent. of sugar. Meat, fish and eggs are entirely free from carbohydrate, save for an extremely small percentage of animal starch (glycogen) to be found in liver. The quantity of carbohydrate in various foods is graphically shown in Fig. 6, page 51, and also in Table 6, page 39.

(*c*) QUESTION. What is protein?

ANSWER. Protein is the food from which muscles and tissues are made. It is therefore an essential constituent of the diet. Examples of protein are lean of meat or fish, curd of milk and white of egg. The yolk contains just as much protein as the white, but it is mixed with fat. Protein is also found in grains, and there is considerable in beans and peas, but very little in other vegetables, and almost none in fruits.

(*d*) QUESTION. What is fat?

ANS. Examples of fat in its pure form are oil and lard. Butter and substitutes for it contain 85 per cent. fat. Rich cream contains about 40 per cent. fat, whereas milk may contain but 3 per cent. Common cheese is one-third fat. The percentage of fat in meat varies from that in fat bacon, in which the percentage occasionally rises to 80, to chicken, in which the percentage of fat is 3 or less. In codfish and haddock the amount of fat is negligible, but in salmon it reaches 13 per cent. Nuts are rich in fat. Fat and carbohydrate are to a large extent interchangeable. In northern climates fat forms a large part of the diet, while in the tropics it is replaced by carbohydrate.

3. QUESTION. Should the diabetic patient know about foods and their relative values?

ANS. Yes. It is of the utmost importance for him to know these things, since (*a*) diabetes is a condition in which the normal utilization of carbohydrate is impaired, and (*b*) the disease is usually due to overeating. Table 6 contains a list of foods which are most commonly eaten by diabetic patients, and, indeed, by normal individuals. It will repay study. Anyone who masters this table will know how to secure a diet containing the desired amount of carbohydrate, protein and fat.

4. QUESTION. What is the proof that the diabetic does not make normal use of the carbohydrate eaten?

ANS. The appearance of sugar in the urine.

5. QUESTION. How much sugar is lost in the urine?

ANS. From a mere trace to two pounds in the twenty-four hours (Fig. 13, page 120). The percentage in the urine seldom amounts to as much as 10 per cent.

6. QUESTION. How is the urine tested for sugar?

ANS. In many ways. The Benedict test is one of the most reliable (page 175).

7. QUESTION. Why are untreated diabetics unusually hungry?

ANS. Because they must eat enough to sustain life and in addition enough to make up for the sugar lost in the urine (pages 118–120).

8. QUESTION. Why are diabetics abnormally thirsty?

ANS. Because they must produce enough urine to dissolve the sugar and thus remove it from the body.

9. QUESTION. What is the aim of treatment?

ANS. The improvement of the condition of the patient, which is best indicated by the excretion of urine which is sugar-free and by a normal quantity of sugar in the blood. See Question 14.

10. Question. What is the nature of the treatment?

Ans. Restriction of the variety and quantity of the food to such an extent as will remove sugar from the urine; the cultivation of the simple life and moderate, regular exercise.

11. Question. What are the sources of sugar in the urine?

Ans. First, the carbohydrate in the diet; second, the protein. From 100 grams of protein it is theoretically possible to form 58 grams of sugar.

12. Question. How else can sugar appear in the urine?

Ans. There is a small quantity of carbohydrate stored in the body, especially in the muscles, liver and blood. This may lead to the excretion of sugar. The protein which forms the tissues of the body may also be drawn upon for food, and just as any other protein may be incompletely assimilated and a portion appear in the urine as sugar.

13. Question. Is sugar formed from fat or alcohol?

Ans. Directly, no, but indirectly, yes. If a patient is sugar-free upon a diet containing a given quantity of carbohydrate, protein and fat it is possible to cause sugar to appear in the urine by the addition to the diet of considerable quantities of fat or alcohol. Apparently whenever the total diet is in excess, irrespective of any particular food, the power of the body to assimilate carbohydrate lessens. Hence the danger to the diabetic in overfeeding.

14. Question. Is sugar present in the blood of healthy people?

Ans. Yes. It amounts to about 0.10 per cent. normally if the blood is examined before breakfast. After a meal the percentage increases to about 0.14 per cent., but drops to normal within approximately two hours.

15. Question. Why is the blood tested for sugar if the urine is known to be sugar-free?

Ans. To determine whether the diet should be increased. The results of a faulty diet can be detected earlier in the

blood than in the urine. The diet should not be increased, as a rule, unless the blood sugar is normal.

16. QUESTION. Is treatment of diabetes beneficial?

ANS. Yes. In the large majority of instances it cures disagreeable symptoms; it prevents dangerous and painful complications; it prolongs life and enables one to lead an almost normal existence. If treatment is not followed the diabetes grows worse.

17. QUESTION. How does the diabetic diet differ from the normal diet?

ANS. By the smaller quantity of carbohydrate, fewer calories and the greater quantity of fat (Fig. 11, page 61).

18. QUESTION. How many calories are produced in the body by the utilization or oxidation of 1 gram of carbohydrate, protein and fat?

ANS. 1 gram carbohydrate produces 4 calories.
1 gram protein produces 4 calories.
1 gram fat produces 9 calories.
1 gram alcohol produces 7 calories.

19. QUESTION. How much food does a diabetic patient need?

ANS. About 20 to 30 calories per kilogram body weight or 10 to 14 calories per pound. This is a little less than for the ordinary individual.

20. QUESTION. How can sugar be removed from the urine, or, in other words, the patient become sugar-free?

ANS. In mild cases by eating less and exercising more, with a consequent loss of weight. In moderate cases by still greater care in avoiding unnecessary food and often by reducing the quantity of carbohydrate, protein and fat. In severe cases by omitting the fat from the diet, by which procedure the danger of acid poisoning is prevented, and then reducing the carbohydrate and protein, or in a few cases by fasting.

21. QUESTION. When the urine of the patient is sugar-free, what is done next?

ANS. A little carbohydrate and protein are first given the patient and then fat, meanwhile testing the urine daily to determine whether the total quantity of food and the different varieties of it can be increased without the return of sugar in the urine or excess of sugar in the blood.

22. QUESTION. What can a diabetic patient do for himself besides keeping the urine sugar-free?

ANS. Be cheerful and also be thankful that his disease is not of a hopeless character, but a disease which his brains will help him to conquer. Keep his temper under control and his skin and teeth scrupulously clean. Avoid people with head colds and sore-throats. Secure a daily action of the bowels. Sleep nine or more hours at night and invariably take at least half an hour off for rest during the day. Exercise moderately in the forenoon, afternoon and evening.

23. QUESTION. How can you help prevent the development of diabetes in your children and friends?

ANS. By explaining to them the dangers of obesity and telling them of easy ways by which to avoid it, such as: (1) to leave the table a little hungry, (2) to satisfy the stomach with unnourishing 5 per cent. vegetables instead of with bread and butter, which are fattening, (3) to omit lunches and candy and sodas between meals, (4) to use skimmed milk instead of cream. Encourage exercise, abundant sleep and energetic, yet restful, vacations.

24. QUESTION. Why are operations often dangerous for diabetic patients?

ANS. Because of the possibility of serious acid poisoning.

25. QUESTION. How can acid poisoning be prevented?

ANS. Practically always by keeping sugar-free. If the patient feels "sick" and is in doubt about acid poisoning he need not worry if he (1) goes to bed; (2) drinks slowly a cupful of hot water, tea, coffee or clear thin broth every hour

or hour and a half, or, if nauseated, takes the same quantity of liquid by enema in the form of salt solution (a level teaspoonful of salt to the pint of water); (3) fasts; (4) moves the bowels by injection; (5) procures a nurse, or has someone to act as nurse, so that he is relieved of all responsibility in carrying out the above treatment; (6) avoids soda or other alkali and (7) notifies his physician.

26. Question. What anesthetics are to be avoided in case of a surgical operation?
Ans. Chloroform and ether.

27. Question. What anesthetics may be safely employed?
Ans. Novocain, cocain, nitrous oxide gas and oxygen, spinal anesthesia.

A diabetic patient at the beginning of treatment should be made to understand that he is taking a course in diabetes.

For successful graduation in the course he should demonstrate his ability:

1. To test the urine for sugar (page 173).
2. To serve himself with approximate accuracy, without scales, 75 grams of a 5 per cent. vegetable (pages 34-42).
3. To record a summary of his diet for the previous day (pages 34–42).
4. To explain the quantity of carbohydrate which it contains (pages 34–42).
5. To state his diet on his weekly fast day (page 104).
6. To describe what he is to do if sugar returns in the urine (page 103).
7. To describe what he is to do if he has reason to believe that he is threatened with acid poisoning (pages 32, 108).
8. To know what to eat while travelling if his usual diet is not available.

CHAPTER IV.

DIABETIC ARITHMETIC.

It is far simpler in computations of the diet to use the metric than the avoirdupois system. Unfortunately, the more general employment of scales registering pounds and ounces makes this at times difficult. For this reason it is well to know both the metric and avoirdupois systems and to be able to convert the one into the other. The essential values are given in Table 4.

Table 4.—The Metric and Avoirdupois Systems Compared.

DRY MEASURE.

30 grams	= 1 ounce[1] :	16 ounces	= 1.0 pound
1000 grams	= 1 kilogram		= 2.2 pounds

LIQUID MEASURE.

30 cubic centimeters	= 1 fluid ounce[2] :	32 ounces	= 1 quart
1000 cubic centimeters	= 1 liter		

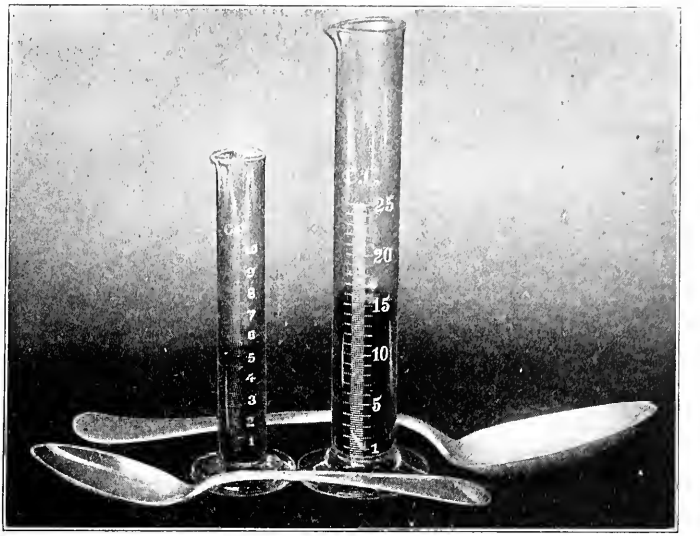
CALORIES.

1 gram carbohydrate	= 4 calories
1 gram protein	= 4 calories
1 gram fat	= 9 calories

The unit of weight in the metric system is a gram. It is easy to visualize the relative value of a gram when it is known that a nickel, five-cent coin, weighs exactly 5 grams, a shredded wheat biscuit weighs 30 grams, and so do three large portions of butter or six of the large lumps of sugar. The average egg weighs 60 grams and a banana (peeled) 100 grams. A kilogram is equivalent to 2.2 pounds. Kilograms become more homelike when one's own weight is changed into kilograms. Thus a weight of 132 pounds avoirdupois is 60 kilograms metric.

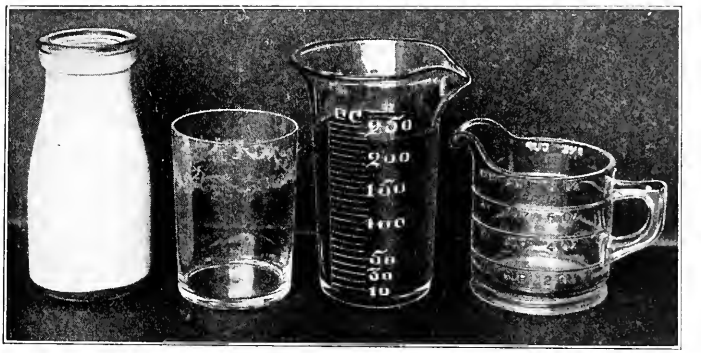
[1] Actually 28.4 grams.

[2] Actually 29.6 grams.



a *b*

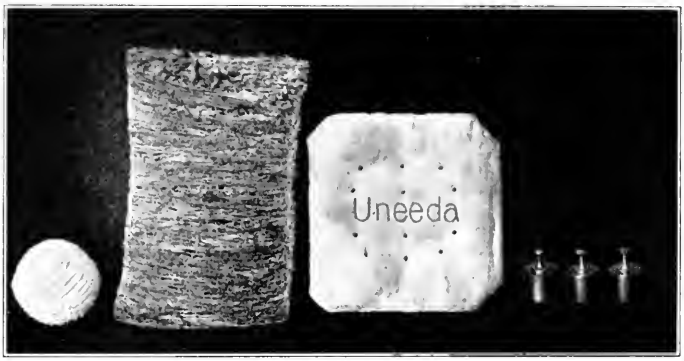
FIG. 1.—*a*, teaspoon, capacity 5 c.c.; *b*, tablespoon, capacity 15 c.c., or ½ ounce.



a *b* *c* *d*

FIG. 2.—*a*, cream, ½ pint or 237 c.c.; *b*, drinking glass, capacity 8 ounces; *c*, 250 c.c. graduate, contains ½ pint fluid; *d*, measuring cup, capacity 8 ounces.

The unit of weight in liquid measure in the metric system is the cubic centimeter. A cubic centimeter of water weighs 1 gram. Thirty cubic centimeters make a fluid ounce,



a *b* *c* *d*

FIG. 3.—*a*, butter, 10 grams; *b*, shredded wheat, 30 grams; *c*, Uneeda Biscuit, 6 grams; *d*, three 10-gram weights, total, 30 grams.

a *b* *c* *d*

FIG. 4.—*a*, 5-gram weight; *b*, lump sugar, weight, 5 grams; *c*, oyster crackers, weight, 5 grams; *d*, Buffalo 5-cent piece, weight, 5 grams.

which is approximately equal to two tablespoonfuls of water. One thousand cubic centimeters are a little more than a quart.

In estimating carbohydrate, protein and fat in the diet or sugar in the urine, enough accuracy is obtained in clinical

work by considering that 30 grams (g.) or 30 cubic centimeters (c.c.) equal an ounce, dry or fluid measure.

The foods upon which diabetic patients live are nearly all printed in Tables 5 and 6 and are shown in Fig. 6 as well. Most of the foods in Table 5 come under the head of 5 per cent. vegetables. By this is meant that not over 5 per cent. (or 5 grams in each 100 grams) of these vegetables may be counted as carbohydrate. As a matter of fact,

FIG. 5.—One teaspoonful (5 c.c.) of Benedict's solution in a test-tube.

lettuce, at the beginning of the first column, contains 2.2 per cent., and string beans, toward the bottom of the second column, occasionally contain as much as 6 per cent. carbohydrate. The average percentage of carbohydrate for the entire group would be about 3 per cent., or 1 gram carbohydrate for each (1 ounce) 30 grams of vegetables. A large saucerful of a 5 per cent. vegetable weighs about 150 grams and contains about 5 grams of carbohydrate. Another reason for reckoning these vegetables at 3 per cent. available carbohydrate is

TABLE 5.—FOODS ARRANGED APPROXIMATELY ACCORDING TO CONTENT OF CARBOHYDRATE.

Vegetables (fresh or canned).

5 per cent.[1]		10 per cent.[1]	15 per cent.	20 per cent.
Lettuce	Tomatoes	String beans	Green peas	Potatoes
Cucumbers	Brussels sprouts	Pumpkin	Artichokes	Shell beans
Spinach	Water cress	Turnip	Parsnips	Baked beans
Asparagus	Sea kale	Kohl-rabi	Canned lima beans	Green corn
Rhubarb	Okra	Squash		Boiled rice
Endive	Cauliflower	Beets		Boiled macaroni
Marrow	Egg plant	Carrots		
Sorrel	Cabbage	Onions		
Sauerkraut	Radishes	Green peas, canned		
Beet greens	Leeks			
Dandelion greens	String beans, canned			
Swiss chard	Broccoli			
Celery	Artichokes, canned			
Mushrooms				
		Fruits.		
Ripe olives (20 per cent. fat)		Watermelon	Raspberries	Plums
Grape fruit		Strawberries	Currants	Bananas
		Lemons	Apricots	Prunes
		Cranberries	Pears	
		Peaches	Apples	
		Pineapple	Huckleberries	
		Blackberries	Blueberries	
		Gooseberries	Cherries	
		Oranges		
		Nuts.		
Butternuts		Brazil nuts	Almonds	Peanuts
Pignolias		Black walnuts	Walnuts (English)	**40 per cent.**
		Hickory	Beechnuts	Chestnuts
		Pecans	Pistachios	
		Filberts	Pine nuts	
Miscellaneous.				
Unsweetened and unspiced pickle, clams, oysters, scallops, liver, fish roe.				

[1] Reckon average carbohydrates in a mixture of vegetables of 5 per cent. group as 3 per cent.; of 10 per cent. group as 6 per cent.

that when they are cooked considerable carbohydrate is lost in the water used in the cooking. The same thing applies to vegetables in the 10 per cent. column, and these vegetables are reckoned as containing 6 per cent. carbohydrate or 2 grams to the ounce. In the 15 per cent. and the 20 per cent. vegetables about their full value is available. Fruit, also, must be reckoned as containing the full quantity of carbohydrate assigned to it in the column in which it occurs. Patients seldom need to know the food values of more than the 21 foods mentioned in Table 6. Patients are advised to buy gram scales, but since many households already have ounce scales, Table 6 is so arranged that the quantities of carbohydrate, protein and fat in an ounce (or 30 grams) of food are placed opposite that food. There are a few exceptions. The values for six oysters and one egg are given instead of for 30 grams of these foods.

TABLE 6.—THE QUANTITY OF CARBOHYDRATE, PROTEIN AND FAT AND THE CALORIC VALUE OF THIRTY GRAMS (ONE OUNCE) OF FOODS IN COMMON USE.[1]

30 grams (1 ounce) contain approximately.	Carbohydrates, grams.	Protein, grams.	Fat, grams.	Calories.
Oatmeal, dry weight	20.0	5.0	2	120
Shredded wheat	23.0	3.0	0	105
Cream, 40 per cent.	1.0	1.0	12	120
Cream, 20 per cent.	1.0	1.0	6	60
Milk	1.5	1.0	1	20
Brazil nuts	2.0	5.0	20	210
Oysters, six	4.0	6.0	1	50
Meat (uncooked, lean)	0.0	6.0	3	50
Meat (cooked, lean)	0.0	8.0	5	75
Bacon	0.0	5.0	15	155
Cheese	0.0	8.0	11	130
Egg (one)	0.0	6.0	6	75
Vegetables 5 per cent. group	1.0	0.5	0	6
Vegetables 10 per cent. group	2.0	0.5	0	10
Potato	6.0	1.0	0	30
Bread	18.0	3.0	0.5	90
Butter	0.0	0.0	25	225
Oil	0.0	0.0	30	270
Fish, cod, haddock (cooked)	0.0	6.0	0	25
Broth	0.0	0.7	0	3
Fruit 10 per cent.	3.0	0.0	0	12

[1] Convenient food scales of 500 grams' capacity with movable dial are made by John Chatillon & Sons, 89 Cliff Street, New York City.

For another reason, in the first line the food value of oatmeal weighed *dry* is inserted, because when oatmeal is cooked the quantity of water which it takes up is so variable that the weight of cooked oatmeal would neither be uniform from day to day nor the same with different kinds of oatmeal, whereas the food values for the *dry* weights of *all* kinds of oatmeal remain approximately the same.

TABLE 7.—THE COMPUTATION OF THE DIET.

Food.	Breakfast, grams.		Dinner, grams.		Supper, grams.		Total grams.	Carbohydrate grams.	Protein, grams.	Fat, grams.
Five per cent. veg.	100	+	200	+	150	=	450	15	8	0
Eggs (2)	2		...		...	=	2	...	12	12
Meat, cooked	...		60		...	=	60	...	16	10
Fish	...		...		60	=	60	...	12	...
Bacon	15	+			15	=	30	...	5	15
Butter	10	+	10	+	10	=	30	...	...	25
Cream, 20 per cent.	30	+	30	+	30	=	90	3	3	18
Oatmeal	15		...		...	=	15	10	3	1
						Totals	=	28	59	81
						Calories per gram	=	4	4	9
						Total calories	=	112 +	236 +	729 = 1077

In the first column of Table 7 is recorded a list of the different foods taken during the day. Of 5 per cent. vegetables 100 grams were given for breakfast, 200 for dinner and 150 for supper, making a total for the day of 450 grams. Two eggs were given at breakfast; meat was given at dinner and fish at supper, but a little bacon appears on the list for both breakfast and supper. Cream containing 20 per cent. fat was given at each meal; oatmeal only at breakfast. Knowing the total quantity of each kind of food given during the day, by using the table of food values (Table 6) one can determine the amount of carbohydrate, protein and fat for each given food. Thus, 450 grams of 5 per cent. vegetables were used. Table 6 shows that for each 30 grams (1 ounce) of 5 per cent. vegetables there is 1 gram[1] carbohydrate and 0.5 gram protein, and therefore in 450 grams (15 ounces) there would be 15 grams carbohydrate and half as many grams protein, or 8 (actually 7.5).

[1] Arithmetically, 1.5 grams, but on account of variation of carbohydrate in vegetables, and on account of losses by cooking, as well as for convenience, reckoned as 1 gram.

Two eggs were given at breakfast. Table 6 shows that the eggs contain no carbohydrate, but that each egg contains 6 grams protein and 6 grams fat—in other words, 2 eggs contain 12 grams protein and 12 grams fat. In the same way one can reckon the amount of carbohydrate, protein and fat in 60 grams of meat (cooked), 60 grams of fish, 30 grams of bacon, 30 grams of butter, 90 grams of 20 per cent. cream (*i. e.*, cream containing 20 per cent. butter fat) and 15 grams of oatmeal. In Table 6 the quantity of carbohydrate in 30 grams of oatmeal is given as 20 grams—consequently in 15 grams of oatmeal there would be half as much, or 10 grams carbohydrate, 3 (actually 2.5) grams of protein and 1 gram of fat.

The actual percentages of carbohydrate, protein and fat in various other foods are given in the large tables on pages 152 to 169. From these it is easy to calculate the quantity of carbohydrate, protein and fat in any food which a patient takes when the total quantity of food eaten is known. Patients and nurses somehow are repeatedly confused by such tables, forgetting that if the quantity of carbohydrate in milk is 5 per cent., 100 grams of milk (or in this case cubic centimeters) would contain 5 grams of carbohydrate, just as 5 per cent. interest on $100 for a year would be $5. Lobster, for instance, contains 16 per cent. protein, and therefore 100 grams of lobster contain (100×0.16) 16 grams protein.

One should be familiar with percentages, because in this way one can often find the values of various foods which are not contained in the 30-gram (1-ounce) table. Should a patient, for example, wish to substitute his 8 grams of protein in the form of 30 grams of meat for 8 grams protein in the form of lobster, this could be done by his taking $(\frac{8}{0.16})$ 50 grams of lobster.

The use of percentages, however, is employed far more in determining the quantity of sugar voided in the urine by diabetic patients in the twenty-four hours. If an individual voids 2000 c.c. (cubic centimeters) of urine and the percentage of sugar is 5 per cent., it is plain that the quantity of sugar lost in the urine during the twenty-four hours would be $2000 \times 0.05 = 100$ grams. As a lump of sugar amounts

to about 5 grams, this would mean that the equivalent of 20 lumps of sugar was lost in the urine in one day.

It is interesting to compare the decrease of sugar in the urine with the reduction of carbohydrate in the diet.

This is shown in Table 8, which is far more simple than it appears to be at the first glance.

TABLE 8.—ILLUSTRATION OF AMBULATORY TREATMENT WITHOUT FASTING OR OMISSION OF PROTEIN. CASE No. 1237. AGE AT ONSET IN SEPTEMBER, 1915, THIRTY-NINE YEARS AND FIVE MONTHS.

Date, 1917.	Urine.				Diet in grams.				Weight, pounds, dressed.	Dietary prescriptions in grams.							
	Volume, c.c.	Diacetic acid.	Sugar. Per cent.	Sugar. Total gms.	Carbohydrate.	Protein.	Fat.	Calories.		Vegetables, 5 per cent.	Fish.	Orange.	Meat.	No. of eggs.	Bacon.	Butter.	Cream, 20 per cent.
Feb. 17	4000	0	8.4	336													
19	1500	0	2.2	33	54	84	0	....	...	720	360	300					
20	1500	0	1.8	27	54	84	0	....	...	720	360	300					
21	1250	0	1.8	23	39	84	0	....	142	720	360	150					
22	1500	0	0.4	6	24	84	0	432	...	720	360	0					
23	1250	0	0.2	3	24	84	0	432	...	720	360	0					
24	1500	0	Tr.	0	24	84	0	432	...	720	360	0					
25	1500	0	Tr.	0	24	84	15	567	139	720	240	0	90				
26	....	0	0	0	24	84	39	783	...	720	120	0	90	4			
27	1250	0	0	0	24	82	57	937	...	720	120	0	90	2	60		
Mar. 1	....	0	0	0	24	82	82	1162	...	720	120	0	90	2	60	30	
3	....	0	0	0	26	84	94	1286	138	720	120	0	90	2	60	30	60
6	....	0	0	0	32	85	106	1422	...	720	120	50	90	2	60	30	90
9	....	0	0	0	42	85	106	1462	136	720	120	150	90	2	60	30	90
13	....	0	0	0	54	87	168	2076									

CHAPTER V.

EFFICIENCY IN VISITS TO A DOCTOR.

A DIABETIC patient frequently fails to get the benefit he should from a visit to his physician because he does not furnish the facts upon which advice for further treatment can be based. Physical appearance alone is by no means a sufficient guide to the careful doctor. Information must be presented concerning the urine, the diet and often concerning the blood. The efficient coöperation of the patient is necessary.

1. **Information Obtained by Examination of the Urine.**—The physician should know whether the urine of the patient is free from sugar, or, if present, how much it contains. This is essential in order to prescribe the diet for the following days. The patient should therefore take with him a specimen of the urine saved from the entire twenty-four-hour amount. To collect such a specimen of urine, discard that voided at 7 A.M. and then save all urine passed up to and including that obtained at 7 the next morning. Take 120 c.c. (4 ounces) of the thoroughly mixed twenty-four hour quantity for examination. Record the twenty-four hour amount of urine, the date and the name on the bottle. The bottle in which the urine is being collected should be kept in a cool place. It is best to procure a bottle[1] for this special purpose sufficiently large to hold the entire twenty-four hour amount of urine. Select a bottle with a large mouth, that it may be more easily cleansed. The bottle should be scalded out daily. It should have a tight-fitting cork. Urine so collected decomposes slowly. On account of the presence of sugar, diabetic urines are prone to ferment, and if fermentation occurs a portion of the sugar

[1] Bottles known to the druggists as percolator bottles and graduated in 100 c.c. up to 2000 c.c. are most convenient.

disappears and invalidates any subsequent test for the quantity of sugar which the urine contained when voided.

From the difference between the total quantity of sugar in the urine and the carbohydrate in the diet it is possible to learn what part of the carbohydrate of the diet has been assimilated by the body and how much has been excreted and so lost. Mild cases of diabetes may consume in the food 100 grams of carbohydrate and lose only 10 grams in the urine; moderately severe cases may excrete five times this quantity, and very severe cases will excrete not only the full amount of carbohydrate eaten, but, in addition, sugar which they have formed from protein.

2. **Information Obtained by Examination of the Diet.**—The quality and quantity of the food eaten during the twenty-four hours while the urine is being collected should be recorded. If thirty minutes are allowed for a visit to the physician's office, it is no exaggeration to say that unless this recording of the diet is neatly done, one-third to one-half of the visit is spent by the physician in learning what the patient has eaten. For this reason patients should always bring a diet list arranged according to some such plan as that shown in Table 7 (page 40).

Even if the quantities of carbohydrate, protein, fat and calories are not worked out by the patient, the grouping together of 5 per cent. vegetables, the summary of the total quantity of butter, cream, meat, eggs, fish, oatmeal and fruit, rather than the hit-or-miss record of the amount taken at each meal, saves an enormous amount of time, which can be far better employed by the physician in giving helpful advice. In other words the patient should go to the physician for treatment rather than for a lesson in grammar-school arithmetic.

3. **Information Obtained by Examination of the Blood.**—Frequently the course of treatment of a case of diabetes is regulated by the quantity of sugar in the blood. If the sugar in the blood can be kept at the normal figure, 0.10 per cent., the patient is unlikely to show sugar in the urine if no change in the diet is made. Estimations of blood sugar are usually made before breakfast, because the blood sugar rises after meals. Consequently, if the blood sugar is to

be tested it should be arranged that this be done before breakfast.

4. **Body Weight.**—If the patient has scales the weight fasting, and preferably undressed on the morning of the visit, should be taken.

5. **Note Book.**—The patient should have a note book, and show it to his physician at each visit. All questions about symptoms and diet which have arisen since the former visit should be neatly set down, with space left for an answer to each question. It is a common error for patients to ask the same question many times, whereas if the answer is written down by the physician the question would thus be answered once for all time. Furthermore, it is a great advantage for a patient to keep a note book, because gradually it becomes valuable for reference, and his whole plan of treatment is systematized.

The note book should contain a statement as to whether sugar has been present or absent in the urine since the last report to the physician. Such data can easily be gathered on one page and again thus save time. When a patient comes to my office with a single specimen of urine instead of a portion taken from the twenty-four hour quantity, and without any record of the food eaten during the preceding day, and starts in to recount that he had nothing but eggs, meat and fish, then later remembers that he had a little cream and various vegetables, then with prompting recalls butter and an orange and a little oatmeal, I always pity him, and on very exceptional occasions am able to recall with satisfaction after the interview Solomon's soliloquy in Proverbs xvi, verse 32.

CHAPTER VI.

HYGIENE FOR THE DIABETIC.

Any agency which promotes physical or mental hygiene is a step toward the prevention of diabetes in the predisposed and the abatement of its severity in those who have acquired it. For years Hodgson has urged in dealing with his patients that they "should be kept mentally indolent and physically active." The experiments of Cannon, Folin and their associates upon the appearance of sugar in the urine of animals, and of both normal and insane individuals following periods of great emotional excitement, have demonstrated the truth of the first half of the motto. Therefore all individuals who have a tendency toward diabetes should be especially urged to take vacations, and the good effect of vacations should be generally pointed out.

Dr. Sabine, of Brookline, has made the remark, based upon the experience of his long general practice, that those of his patients who took active camping trips in the woods bore the stress of modern life best. By this means exercise was combined with mental relaxation. That the good effects of each last for months is not hard to believe. It is only natural to conclude that if the muscles, in which is stored one-half of the carbohydrate of the body, are kept in good condition by training a favorable effect must be exercised upon the general metabolism of carbohydrate. Pedometers are to be encouraged. It is better to discuss how far you have walked than how little you have eaten. Stimulated by Dr. Allen the exercise of diabetic patients has been gradually increased, except those unduly weak or in a dangerous condition upon entrance to the hospital. The effect of this increase of exercise upon the well-being of fat diabetics has been pronounced, and it is striking how many miles a semi-

ill or obese diabetic patient can learn to walk during two weeks. The patients are encouraged to take their walks soon after meals and to go outdoors at least five times in the day. Not alone are the good effects of exercise shown by the freedom of the urine from sugar and an increased carbohydrate tolerance, but by improved circulation and general well-being. No case should be considered too far advanced for an attempt at muscular redevelopment. Fasting diabetics, as a rule, appear to do better when up and about the wards for a few hours than when in bed. However, caution is necessary in suggesting this plan to severe cases of diabetes. Two patients so weak from lowered vitality that they could not stand, through the help of skilful massage and carefully planned dietetic treatment again began to walk.

If the patient, by means of exercise, can have 5 grams more of carbohydrate a day the added comfort will be enormous, for the addition of 5 grams of carbohydrate to a diet in a case of severe diabetes brings almost untold joy. It allows various alternatives, such as half a small orange, 70 grams of strawberries, a small tablespoonful of cooked oatmeal or a potato of the size of a pullet's egg.

Case No. 1024, a lady, aged seventy-eight years, not only took exercise in the forenoon and afternoon, but went out for her walk in the evening with a flash light.

Case No. 804, a patient whose diabetes changed from severe to moderate and finally from moderate to mild under his own care at home, wrote that he considered exercise of the greatest importance. He said that he had the best garden of anyone in his city.

Case No. 352 outlived his expectation of life, having had diabetes twenty-three years, and throughout this time having led a most active existence. He wrote:

"First, it is very hard to start the exercise, and the less one feels inclined to start the more one needs it. Second, it is neither necessary nor desirable that it should be violent. I found a quiet ride of an hour, walking or jogging after taking something on the stomach, started up my old metabolism for the whole day. If I rode hard I got tired out."

Finally, it is astonishing how much exercise a diabetic in training can take. One of my severe cases, living on a strict diet, several years ago walked between twenty and thirty miles in one day. Inquiry elicited the following letter from Case No. 783, a Harvard student, who frequently shows a small trace of sugar, a case which borders upon the renal type of diabetes. The blood sugar one morning before breakfast was 0.07 per cent.:

CAMBRIDGE, MASS., Dec. 1, 1915.

"I first noticed the effect of exercise last spring. I was rowing for exercise at the time and observed that if I went out on the river about a half-hour after lunch and rowed for an hour or less the test would not show any sugar in the urine at any time during the afternoon, even though I ate potatoes and a small amount of bread for lunch. But if I ate potatoes (no bread) without so exercising the test always showed sugar about two hours after the meal."

Rest is essential. A tired child is put to bed and wakens refreshed; one of the most noted surgeons in our country is not ashamed to leave his guests at the table and lie down for fifteen minutes after his luncheon; the best treatment for a failing heart is to put its owner in bed for a week. Diabetic patients should rest often, should never get tired and should avoid athletic contests. The diet is designed to give a rest to the pancreas. Sleep nine hours and more if you can, and get another hour of rest by day. Short periods of complete relaxation yield maximal returns.

Forget you have diabetes and do not talk about it with others. This is one reason for not using saccharin, and another is to avoid the perpetuation of a sweet taste, thus reviving the thought of the previously unrestricted diet.

Mental diversion is desirable, but anxiety is harmful. Heavy responsibilities should be avoided as well as nervous upsets and emotional excitements. It is almost as dangerous for a diabetic to get angry as it is for a man with angina pectoris. Case No. 1157 had been sugar-free for five days, but it came back when he had an important conference with one of his superintendents.

Wear warm clothes instead of staying by the radiator or in an overheated room.

The change in the mental attitude of patients during the course of treatment is a gratifying encouragement to the physician. Untreated diabetics after a moderate number of years usually show depression, and with women this often becomes pronounced. In the first ten years of my experience with diabetes the tendency of such patients to cry impressed me greatly, but even then, with the methods in vogue, it was interesting to see how depression disappeared with the decrease or disappearance of sugar in the urine. This could not be explained by the mental encouragement which a patient derived from his knowledge of the decrease in sugar excretion. Even when patients became sugar-free but developed acidosis, mental symptoms often improved, and to so great an extent that one could say that with treatment, even although it did end in coma, the patient enjoyed life far more thoroughly than when untreated. During the last five years the mental attitude of the patients has improved still more. The enthusiasm about new methods of treatment has been so great as to account partially for this; but the actual improvement in health which the patients have felt has been of more importance. Greeley explained to my patients how diabetes has largely been robbed of its terrors. He urged the simple life as a great aid in treatment and told them not to try to be first in the Iberian village and be ill, but rather to be second in Rome and keep well. He told them to have a hobby and not to make it a labor; to be cheerful and to keep their minds occupied, and, so far as possible, to continue the previous currents of their lives.

CHAPTER VII.

THE DIET OF NORMAL INDIVIDUALS.

Food and Fuel.—Foods are fuel for the body, just as gasoline is fuel (food) for an automobile. Man and automobile depend upon fuel as a source of energy. In case the gasoline gives out the automobile will stop, but if the food gives out the man will not immediately die, because he carries a good deal of the fuel stored up in his body, first and chiefly as fat, second, a lesser amount in the form of protein in the muscles and various tissues, and third, a little in the form of carbohydrate as animal starch (glycogen) and sugar in the liver, muscles and blood.

A fasting man at the Carnegie Laboratory in Boston went without food for thirty-one days, living upon his reserve supply of food.

Just as one can measure how much gasoline is required for an automobile to run 100 miles, so one can measure how much food is necessary for a man to live for twenty-four hours and do a given amount of work. Small automobiles require less gasoline than large automobiles, and this is pretty much true of individuals, for the food which they need depends upon their weight. There are exceptions. Children require proportionately more food because they are growing, and old people require less because they are quieter. We cannot measure the quantity of food which we use in as simple a way as we can measure the fuel gasoline which the automobile requires, because we depend upon three kinds of food. However, it is obvious that if the food value of 1 gram of each of the foods, carbohydrate, protein and fat, is known and also the quantity of each food which is eaten the total food value of the diet for the patient can then be determined.

The nutritive value of the diet is readily computed by

referring to Table 6, page 39, and Fig. 6, and by bearing in mind the caloric values of the various foods. (See page 31, Question 18). Table 7, page 40, will serve as an example.

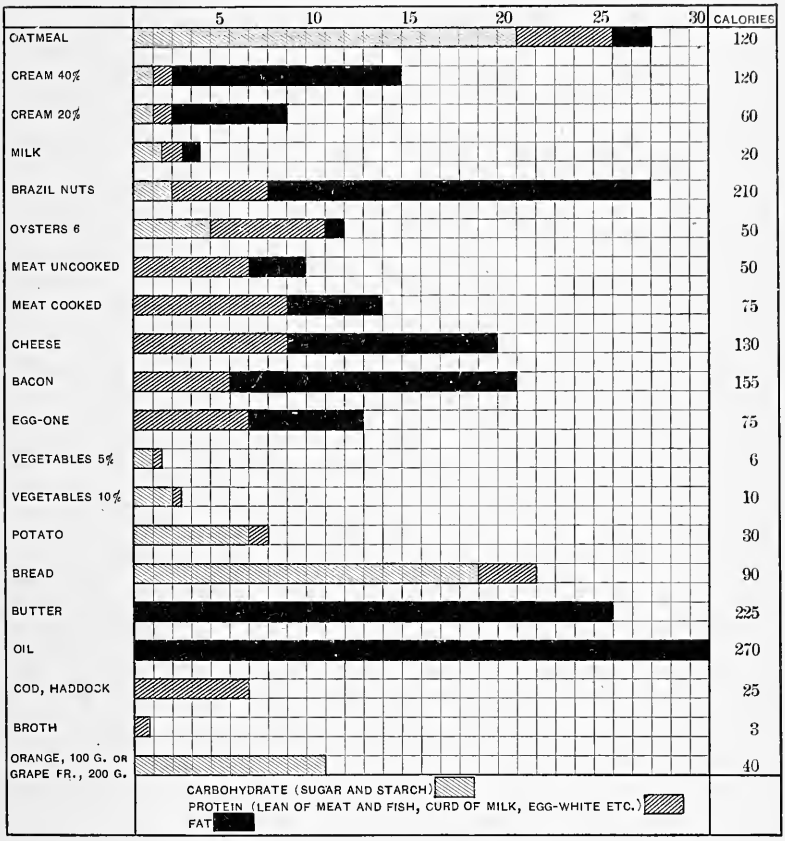


FIG. 6.—Diet table showing total calories and quantities in grams of carbohydrate, protein and fat in 30 grams (1 ounce) of various foods. Each lineal division represents 1 gram.

The quantity of food which an individual requires has been estimated in various ways. One method has been to weigh the amount of food eaten by a large number of individuals

and then calculate the amount consumed by each individual. The accuracy of such a method depends upon many factors, and obviously a man's allowance of food should not be compared with his actual consumption of food. Soldiers are assigned rations, but it is improbable that they eat what they are allowed. A comparison of the French and American rations is significant. The rations furnished soldiers in various armies are reported to be as shown in Table 9.

TABLE 9.—SOLDIERS' RATIONS.

	Carbohydrate, grams.	Protein, grams.	Fat, grams.	Calories.
United States garrison ration	651	185	141	4751
Russian ration in Manchurian war	487	215	90	3717
British ration	524	224	195	4962
Italian ration	560	145	93	3745
French ration (normal)	402	130	117	3181

Another method allows the food required by a given individual to be calculated far more accurately. By this method the total heat given off by a man at rest or at work has been measured.

This total heat represents energy which has been derived rom the oxidation of the three foodstuffs—carbohydrate, protein and fat. It is unessential whether the foodstuffs oxidized have been taken within a few moments as food or whether they represent food deposited in the body as fat (fat tissue), protein (muscle tissue) or carbohydrate (glycogen, *i. e.*, animal starch). Knowing the total heat given off it is not a difficult matter to calculate how much carbohydrate, protein and fat would be required to produce it.

Experiments have demonstrated that the heat which is liberated in the body from the combustion of 1 gram of protein or of carbohydrate produces 4 calories, from 1 gram of fat 9 calories and from 1 gram of alcohol 7 calories. Fat, as would be expected is more than twice as nourishing as carbohydrate or protein. With these figures in mind it is easy to estimate with sufficient exactness from dietetic tables the calories in the diet required to replace the heat given off by the body during the period of the experiment. The result of such calculations is embodied in what follows.

Individuals with sedentary occupations require approximately 30 calories per kilogram body weight. Thus a man weighing 70 kilograms, or 154 pounds (1 kilogram = 2.2 pounds), would need 2100 (70 x 30) calories. The caloric needs of the body, however, vary not only from day to day but from moment to moment. Thus an individual lying down requires not over 25 calories per kilogram body weight, but at moderate work 30 or more. So much of the twenty-four hours is spent sleeping that the individual saves then what he uses at other periods. To walk one hour on a level road at the rate of 2.7 miles an hour requires 160 calories above that of keeping quiet according to Lusk. For a man to ascend a flight of stairs ten feet high about 3 calories are necessary. Table 10 shows the calories needed according to the amount of work done.

TABLE 10. — CALORIES REQUIRED DURING TWENTY-FOUR HOURS BY AN ADULT WEIGHING SEVENTY KILOGRAMS (ONE HUNDRED AND FIFTY-FOUR POUNDS).

Condition.	Calories per kilogram, body weight.	Calories per pound, body weight.	Total calories.
At rest	25 to 30	11 to 14	1750 to 2100
At light work . .	35 to 40	16 to 18	2450 to 2800
At moderate work .	40 to 45	18 to 20	2800 to 3150
At hard work . .	45 to 60	20 to 27	3150 to 4200

Children require far more food than adults, because of growth and increased activity. This is shown in Table 11.

TABLE 11.—CALORIC NEEDS OF CHILDREN DURING TWENTY-FOUR HOURS.

Age in years.	Weight: kg.	Weight: pounds.	Calories per kilogram. body weight.	Calories per pound, body weight.	Total calories.
2	12	26	80	36	960
6	20	44	70	31	1400
12	36	80	50	23	1800

Composition of the Normal Diet.—The ordinary diet for a man at moderate physical work would contain about 400 grams of carbohydrate, 100 grams of protein and 100 grams of fat. This would amount to 2900 calories in the twenty-four hours, or about 40 calories per kilo for an individual

weighing 70 kilograms (154 pounds). These figures would be proportionately reduced both for those of lower body weight and for those with lighter occupations who would require nearer 30 calories per kilo. As age advances the metabolic requirements are lessened; thus if 2000 calories are required at thirty years, 1800 calories will suffice at seventy and 1600 at eighty years of age. An individual weighing 45 kilograms (99 pounds) could get along very comfortably in old age on 1000 calories a day.

TABLE 12.—THE CARBOHYDRATE, PROTEIN AND FAT IN THE DIET OF A MAN DOING MODERATE WORK, WEIGHT 70 KILOGRAMS (154 POUNDS).

Food.	Quantity, grams.	Calories, per gram.	Total calories.
Carbohydrate	400	4	1600
Protein	100	4	400
Fat	100	9	900
			2900

Chittenden, in his painstaking and scientific manner, accomplished an immense amount of good when he showed that people ordinarily consumed much more food than physiological needs demand. He suggests that it is more than probable that this excess of food is, in the long run, detrimental to health, weakening rather than strengthening the body and defeating the very object of nutrition.

From the preceding statements it will be seen that more than half (55 per cent.) of the energy of the diet of the normal individual consists of carbohydrate. These figures are only approximate, but they leave no doubt as to how large a place sugar and starch occupy in the daily ration. Fig. 7, page 55, shows graphically the relative caloric value of the different foodstuffs in the total diet.

The quantity of protein in the normal diet is probably decidedly less than 100 grams. From Cannon's investigations at the Harvard Medical School it would appear that hardworking medical students, with their regular activities, eat about 90 grams each day. There is comparatively little doubt but that it is safe for an individual to get

along on 1 gram protein per day for each kilogram body weight, and a doctor's worry ends if his patients secure 60 grams protein, even though the students ate rather more. Protein is animal food to a large degree; hence its cost. This is an added reason for being sparing in the use of protein. There is also still another reason, for when an excess of protein is burned the other foods are also consumed more rapidly, and there is more chance for the heat so produced to go to waste.

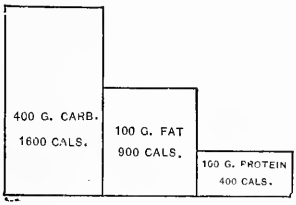


FIG. 7.—The relative caloric value of protein, carbohydrate and fat in a normal diet.

The quantity of fat in the normal diet varies partly from choice and partly from economic reasons. In general in those cases in which the carbohydrate in the diet is high the fat is low, and *vice versa*. The Voit standard placed the fat at 55 grams, but in a series of 1300 dietary studies of families, carried out among different races and in different countries, it was shown that the average quantity of fat eaten was about 135 grams (4.5 ounces) per person per day, the variation recorded being from 45 to 390 grams per person per day.

The more agreeable varieties of fat, such as butter, cream and oil, are expensive foods. Fat is also a concentrated food, not only because it has twice the caloric value of either carbohydrate or protein, but because it occurs more frequently in pure form. Oil, butter and lard contain little water, whereas except for pure sugar and starch most carbohydrates and proteins are diluted five to ten times with water.

The chief source of error in calculating the total caloric value of the diet, and especially of the diabetic diet, is in the estimation of fat. Anyone can realize this upon examining

a piece of meat with its fringe of fat. The fat in bacon is most variable, and in amount its value can only be approximately estimated. Portions of bacon lose from 43 to 67 per cent. of fat in the cooking. For this reason some physicians prefer to have the allowance of bacon for their patients weighed uncooked and then the fat which escapes in the process of cooking can be utilized in the preparation of their other food. As the proportion of protein to fat in different samples of bacon varies considerably the inconvenience of weighing the bacon uncooked has hardly seemed to me to counterbalance the questionable gain in accuracy. For this reason my patients weigh their bacon after it is cooked.

Eggs in some cities by law must weigh a pound and a half a dozen, an average of 60 grams (2 ounces) apiece. Such eggs contain approximately 6 grams of protein and 6 grams of fat. How gross our caloric reckonings are is obvious if a collection of eggs is weighed and the minimum and maximum weights noted. The weight of the heaviest egg in a collection of 56 eggs was 72 per cent. more than that of the lightest. The 6 grams of protein are equally divided between the white and the yolk, but the 6 grams of fat are all in the yolk. When protein without fat is desired in the diet one whole egg and the whites of two others can be made into a dish of scrambled eggs. This would contain protein 12 grams and fat 3 grams.

The weight of one egg shell is usually about 7 grams.

Milk may be employed in the treatment of diabetes, but it must be prescribed and taken with care, because of the large quantity of carbohydrate, protein and fat which it contains. A glass of milk is drunk so easily that one is apt to forget that it contains 12 grams carbohydrate, 8 grams protein and 8 grams fat. Fig. 8, page 57, makes this clear. Skimmed milk and buttermilk contain the same quantity of carbohydrate and protein as whole milk, but differ from it in the absence of fat. Thirty c.c. (1 ounce) of skimmed milk, whole milk or buttermilk contain 1.5 grams of carbohydrate and 1 gram of protein, and 1 quart of skimmed milk contains approximately 48 grams carbohydrate and 32 grams protein. Whey contains 5 per cent. carbohydrate, but practically no

protein or fat. Cream and koumiss contain about 3 per cent. carbohydrate, or 1 gram to the ounce.

Diabetic patients seldom become sugar-free on a milk diet. They may become sugar-free if so little milk is taken that the patient is partially fasting.

The high nutritive value of cream, butter and cheese is evident from Fig. 8. This makes these special milk products desirable, but if carelessly taken, danger of acid poisoning arises from the large amount of fat which they contain. The high protein value of milk—1 gram to the ounce, 32 grams to the quart—is important to consider, not alone because

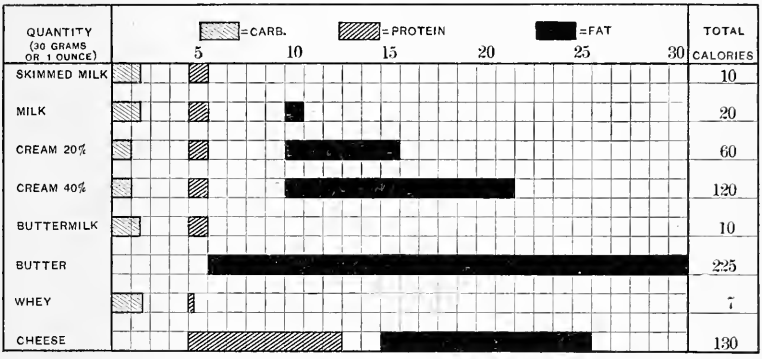


FIG. 8.—Milk and milk products. Carbohydrate, protein and fat in 30 grams, or 1 ounce. Each lineal division represents 1 gram.

of the protein itself, but also because from protein sugar is often formed. Cheese contains about half again as much protein as fish.

Repeatedly physicians and patients have requested me to arrange the common articles of the diabetic diet mentioned in Table 6 in terms of household measure. To a considerable extent this is impracticable, because the diabetic diet deals with so small a quantity of carbohydrate. For this reason the only safe way for diabetic patients at the commencement of their training is to weigh their food. After a few days of weighing, patients can select utensils

from their own pantry or china-closet which conform to the size of the portions of their own special diets and use these exclusively. By this means needless weighing is avoided. Two such utensils are shown in Fig. 9.

The ramekin level full of Quaker Oats holds 30 grams. When packed tightly with 5 per cent. vegetables or potato it holds 90 grams, but when filled loosely in the ordinary manner, 75 grams. The pitcher holds 60 c.c., or 2 ounces, and is graduated to 15 c.c.

a *b*

FIG. 9.—*a*, a ramekin this size holds 45 c.c. of water, or 3 tablespoonfuls; *b*, a pitcher graduated to 15 c.c.; capacity, 60 c.c.

Patients and physicians often err in thinking their computations of the diet are extremely accurate. In order to demonstrate the errors which easily arise from general statements about foods, Fig. 10, page 59, is inserted.

It is manifestly inaccurate to allow one orange in lieu of 10 grams carbohydrate, for, as the illustration shows, three oranges may contain respectively 10, 15 or 20 grams carbohydrate.

Similar wide variation in carbohydrate content occurs in grape fruit. The oranges from left to right are sold under the trade names of 126, 170 and 250 (to the box) and the grape fruit under the trade names of 28, 64 and 96 (to the box). At the New England Deaconess and Corey Hill Hospitals

oranges and grape fruit are now prescribed according to the weight of the peeled pulp. Errors in eggs may compensate themselves, because the eggs average about 60 grams. Potatoes vary enormously in size, the diagram of the smallest

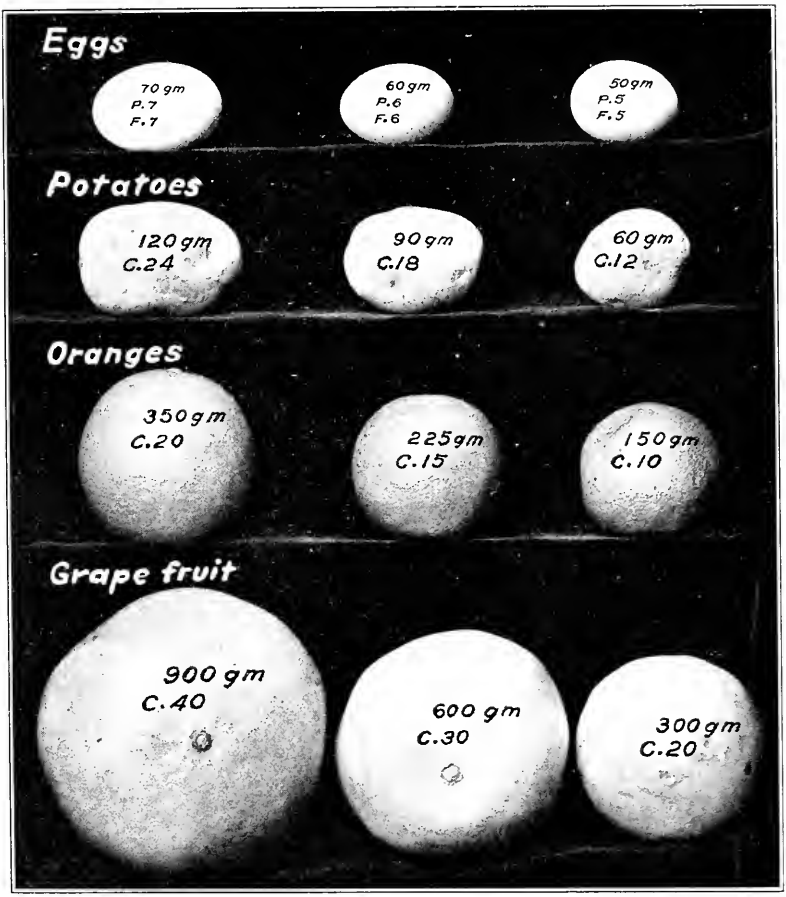


FIG. 10.—Variations in the sizes of common foods. *C.* = carbohydrate; *P.* = protein; *F.* = fat.

shown here is in reality the size of an egg. It is quite unsafe to guess at the size of a potato.

It is partly on account of the ease with which large errors in the carbohydrate content of food may occur that it is desirable to give to patients with a low carbohydrate tolerance their carbohydrate in the form of 5 per cent. vegetables exclusively, for an error in weight, reaching 120 grams (4 ounces) could not exceed 4 grams of carbohydrate.

CHAPTER VIII.

THE DIET OF DIABETIC INDIVIDUALS.

The Normal and Diabetic Diets Compared.—Four-sevenths of the calories of the diet in health are made up of carbohydrate, two-sevenths of fat and one-seventh of protein; but in diabetes the diet is composed almost exclusively of the latter two foods. This is not discouraging, for until recently the Eskimo's diet contained only about one-seventh carbohydrate. It takes time and experience to learn to live successfully upon a diabetic diet, and it is only with time that the body adjusts itself to a diet with so marked a reduction of carbohydrate and so marked an increase in fat. It is indeed wonderful that it is possible for the body to do so at all.

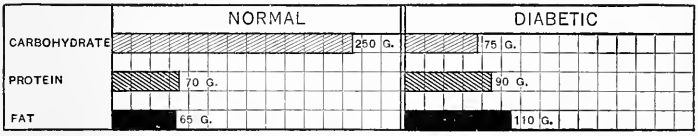


Fig. 11.—The diet of a normal and of a diabetic individual compared. Weight of each patient 60 kilograms ($60 \times 2.2 = 132$ pounds). Foods arranged in grams.

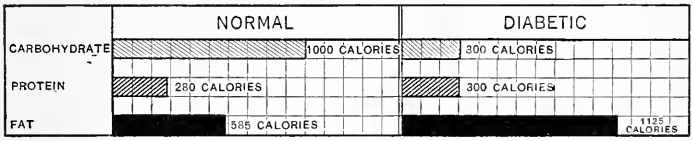


Fig. 12.—Foods arranged in calories. Same as Fig. 11.

In Figs. 11 and 12 the carbohydrate, protein and fat in the normal and diabetic diets are graphically compared by weight and by calories. It is assumed in this comparison that a

diabetic patient has a tolerance for 75 grams carbohydrate. It will be noted that the total caloric value of the diabetic diet is slightly less than the normal diet. This is so arranged with design, partly because the diabetic patient is usually less active and partly because, by a slight restriction of diet, the opportunity for improvement of the diabetes is favored.

Caloric Needs of the Diabetic.—The diet of the diabetic patient should contain, except for brief intervals, the minimum number of calories which the normal individual would require under similar conditions. Many normal individuals, in my opinion, actually live upon less than 30 calories per kilogram body weight, and repeatedly one sees diabetic patients over fifty years of age who comfortably live upon less for long periods. This is true only for the treated diabetic. If the patient is allowed more than the minimum amount of food there is far more likelihood that a portion will be unassimilated and appear as sugar in the urine. One of the first rules for the diabetic patient to learn is never to overeat. He should be a model in food conservation for his household. As a matter of fact during scientific treatment, he always returns a clean plate because his appetite is always equal to the food allowed.

TABLE 13.—THE EFFECT OF THE RESTRICTION OF FOOD UPON DIABETIC MORTALITY.

	Berlin.	Munich.	Breslau.
1913	409	105	100
1914	467	104	115
1915	383	101	113
1916	331	82	78
1917	264	73	72
1918	177	77	51

The beneficial effects of a low diet upon diabetic patients were repeatedly observed in Germany during the years 1914 to 1918. This is well shown in a paper by Rosenfeld, of Breslau, from which Table 13 is constructed. Even in the United States the census reports for 1916 and 1917 show for almost the first time in a generation a halt, and in fact even a decline, in the mounting death-rate from diabetes (see Chart, page 26). With the resumption of abundant food it

is probable that the frequency and unfortunately the mortality of diabetes will again increase. What effect the diminution in the supply of alcohol and the coincident increase in the consumption of candy will exercise upon diabetic statistics is problematical. Very likely it will be eventually possible to determine whether the calories omitted as alcohol are offset by the addition of sugar.

Carbohydrate in the Diabetic Diet.—The total carbohydrate in the diet of diabetic patients is almost invariably restricted and seldom exceeds 100 grams. This is a decrease to approximately 25 per cent. of the normal carbohydrate ration. It so radically changes the composition of the normal diet as to make it self-evident that rapid changes from a normal to a diabetic diet containing even 100 grams carbohydrate might easily cause indigestion in normal as well as in diabetic individuals. The decrease in carbohydrate must be eventually compensated by an increase in fat.

The Estimation of the Carbohydrate in the Diabetic Diet.—The quantity of carbohydrate in various foods is easily calculated and far more simply than is usually thought. (See Table 6, p. 39, with accompanying text.)

Carbohydrate in Vegetables.—It would appear time-consuming to determine the amount of carbohydrate in the various vegetables which the patient eats in twenty-four hours, and this is actually the case. Fortunately the content of carbohydrate in the 5 and 10 per cent. groups of vegetables is so small that one is justified in the vast majority of cases in accepting an average figure for the group. It is true that there is considerable variation in each group in Table 5, but the average content is not far from that represented, the error being on the lower side. This does not hold for string beans, because often trouble occurs from the beans having developed into maturity, thus greatly increasing their content in carbohydrate. Many an unexplained trace of sugar in the urine has undoubtedly occurred in this way. "Refugee" beans are an excellent variety. "Kentucky Wonder" beans are also highly recommended for the garden, because they last so long.

One will not be very wrong if he considers the maximum amount of carbohydrate which a diabetic will secure from 5 per cent. vegetables in the twenty-four hours as 20 grams. This is why in mild cases of diabetes it is unnecessary to weigh the vegetables, for it is improbable that a patient will eat too much of these. Even a moderately severe diabetic can partake very freely of these, and particularly is it the case when those selected are lettuce, cucumbers, spinach, asparagus, rhubarb, endive and vegetable marrow.

Loss of Carbohydrate in Cooking Vegetables.—The longing for carbohydrates is occasionally relieved by giving patients food which simulates carbohydrate, yet in reality is free from it. Foods of this type are free from carbohydrate and fat and contain a negligible amount of protein. Washed vegetables constitute a food of this type. Vegetables lose carbohydrate in the cooking, and this loss is favored (1) by changing two or three times the water in which they are prepared; (2) by preparing the vegetables in finely divided form so that the water can have easy access to the whole mass and thus dissolve out the carbohydrate.

Von Noorden[1] pointed out that 100 grams of raw spinach contained 2.97 grams carbohydrate, but cooked spinach only 0.85 gram. Similarly 100 grams of ripe peaches contained 9.5 grams carbohydrate, but when boiled and the water changed, only 1.8 grams. Allen[2] has utilized this method of removing carbohydrate from vegetables, and thus allows patients to have bulk in their diet. He terms vegetables so prepared "thrice-cooked" vegetables. "Under these conditions the vegetables may be boiled through three waters, throwing away all the water. Nearly all starch is thus removed. The most severe cases generally take these thrice-cooked vegetables gladly and without glycosuria." Patients often say that it makes little difference to them whether the vegetables are thrice washed or not. It is easy and useful to add a little salt, and if desired the vegetables can be flavored with meat juices or meat extracts. The vegetables which most readily part with

[1] Von Noorden: Die Zuckerkrankheit, Berlin, 1912, p. 306.
[2] Allen: Boston Med. and Surg. Jour., 1915, clxxii, 241.

their carbohydrates are spinach, celery and cabbage. Canned asparagus and canned spinach, carrots and rhubarb should be washed six times. The carbohydrate in cauliflower is removed with great difficulty and this vegetable had best not be used for this purpose. Professor Wardall reports that three washings will remove the carbohydrate from beets and seven washings that from parsnips. Presumably this is due to the carbohydrate in these vegetables being more largely in the form of soluble sugar than in that of the relatively insoluble starch.

The Carbohydrate in Various Foods.—1. *Potatoes.*—The variation in the percentage of carbohydrate in potatoes before and after cooking is negligible, save with potato chips, in which on account of the loss of water in their preparation the carbohydrate is more than doubled. Emphasis should be laid upon the comparatively small amount of carbohydrate in potato in proportion to its bulk in comparison with the large percentage of carbohydrate in bread. A considerable number of my milder cases of diabetes, by giving up bread and bread preparations entirely, have been able to eat potatoes freely. In prescribing potatoes for diabetic patients it is desirable to designate baked potatoes. These can be eaten agreeably together with the skins when they have been carefully cleaned with a scrubbing brush in the kitchen. Baked potatoes are advantageous in two ways: the skins are quite an addition to the meager diet of the diabetic, and, furthermore, they counteract constipation.

2. *Nuts.*—Nuts containing 15 and 20 per cent. carbohydrate are probably far less objectionable than most other foods with a similar carbohydrate content. This is due to the fact that in such nuts as almonds and peanuts a larger part of the carbohydrate is in the form of pentosan, galactan or other hemicelluloses, which probably do not readily form sugar. There is a field for investigation open here.

3. *Fruit.*—Fruit is most desirable for a diabetic patient if his tolerance will allow him to take it. The taste is agreeable, it serves instead of a dessert and so relieves the patient of the embarrassment of sitting idly at the table when others

are eating. The best varieties of fruit for diabetic patients are grape fruit (5 per cent.), strawberries (7 per cent.) and oranges (11 per cent.). These fruits are safer for the patient than apples (15 per cent.), because they contain 5 to 10 per cent. less carbohydrate, and are more satisfying. Furthermore, it is less easy thoughtlessly to eat an orange than an apple and thus break dietetic restrictions.

At present my patients use the following equivalents in their choice of fruits as representing 10 grams carbohydrate (Table 14).

TABLE 14.—EQUIVALENTS OF 10 GRAMS CARBOHYDRATE IN VARIOUS FRUITS.

	Grams.
Orange pulp	100
Grape fruit pulp	200
Strawberries	150
Blackberries	100
Raspberries	75
Peaches	75
Blueberries	65
Banana	50

4. The quantity of carbohydrate in a *very small* orange is about 10 grams. The same statement will apply to one-half a small-sized grape fruit. One will not be far wrong to consider that one compartment of a very small orange contains 1 gram carbohydrate. The illustration on p. 59 shows that larger oranges and larger grape fruit easily contain twice as much carbohydrate as do the smaller varieties.

5. *Bananas.*—Bananas can seldom be taken by diabetic patients because the content of carbohydrate is so high, being equivalent to that in potato. In general the riper a banana, and for that matter any vegetable or fruit, the more starch in it has changed to sugar; and also the more carbohydrate it contains. Since unripened fruits with their lower carbohydrate content can be made palatable by cooking, a way is afforded for diabetic patients to use them.

6. *Ripe Olives.*—Ripe olives make a pleasing change in the diet. They contain 4 per cent. carbohydrate in contrast to green olives, which contain 1.8 per cent. Furthermore, ripe olives are more easily digested. Five ripe or

10 green olives contain 1 gram carbohydrate and 5 grams of fat. The quantity of protein in ten olives is about 1 gram.

7. *Milk.*—The carbohydrate in milk is in the form of lactose and can be reckoned at 5 per cent., or 1.5 grams per 30 c.c., or 1 ounce. It is the same in skimmed milk, buttermilk and whey; but cream and koumiss contain about 3 per cent., or 1 gram carbohydrate to the ounce. Buttermilk contains essentially the same quantity of carbohydrate and protein as milk, but only a trifling amount of fat.

8. *Oatmeal.*—Oatmeal is two-thirds carbohydrate. In calculations one should always be guided by the dry weight, because the different preparations vary greatly in bulk and weight when cooked. It is a simple matter for a few days to weigh out 30 grams (1 ounce) of dry oatmeal containing 20 grams carbohydrate, have it cooked and note the bulk. By dividing the oatmeal thus cooked into four portions each would contain 5 grams carbohydrate.

In weighing foods with the usual variety of scales one should never attempt to weigh out quantities as small as 5 grams. A more reliable result is obtained by weighing out multiples of 5 grams and then dividing into enough portions to make each portion 5 grams.

A Shredded Wheat Biscuit, weight 30 grams, can be used interchangeably with 30 grams of oatmeal. Its uniform size and its availability at all times make it an extremely convenient article of food for a diabetic patient.

	Carbohydrate.	Protein	Fat.
Oatmeal, 30 grams (dry)	20	5	2
Shredded Wheat Biscuit	23	3	0
Uneeda Biscuits (4)	20	3	2

9. *Bread.*—It is undesirable to give bread to diabetic patients unless their tolerance is very high, because they can take so little without causing glycosuria that the bread is simply an aggravation. An error in the weight of 1 ounce of a 5 per cent. vegetable amounts to 1 gram carbohydrate, of potato to 6 grams, but of bread to 18 grams. The carbohydrate in white wheat bread amounts to about 53 per cent. If the bread is toasted, enough water is lost to raise

the percentage of carbohydrate in the toast to about 60 per cent. If the bread is made with water instead of milk, but without sugar, the carbohydrate content is lowered and may amount to only 45 per cent. Coarse breads if made without sweetening or milk would contain slightly less carbohydrate. If the tolerance for carbohydrate is less than 50 grams, breads are best avoided.

Crackers and zwieback contain still less water than toast, and in consequence the percentage of carbohydrate is raised to the neighborhood of 70 per cent. Many gluten breads upon the market contain as much as 30 per cent. carbohydrate.

Protein in the Diabetic Diet.—The quantity of protein required by diabetic patients varies with the age, weight and activity of the case as well as with the condition of the kidneys. It is a safe rule at the beginning of treatment to attempt to increase the protein gradually up to the same quantity as that required by a normal individual. This is approximately 1.5 grams per kilogram body weight.

Chittenden points out that 60 grams (one-half the old standard protein) are quite sufficient to meet all the real physiological needs of the body under ordinary conditions of life, and that with most individuals not leading an active out-of-door life even smaller amounts will suffice. Chittenden, weighing 57 kilograms, and Mendel weighing 70 kilograms, lived respectively on 34 and 41 grams protein daily, the former for nine and the latter for seven months. Until the Chittenden low protein diet is proved to be entirely satisfactory as a permanent diet for healthy individuals it is best not to have recourse to it for long periods in the treatment of diabetes. Temporarily small quantities may be given, but safety lies not far from 1 gram protein to each kilogram body weight.

It has been claimed that vegetable proteins give rise to less carbohydrate than do animal proteins. As a matter of fact, carbohydrate may be formed out of any protein.

Meat and Fish.—These two articles constitute the chief sources of protein in the diabetic diet. The study of the chemical composition of these foods is simplified for the

diabetic patient by the fact that except in liver and shell-fish, carbohydrate is absent. Even in liver the quantity of carbohydrate is almost negligible when we consider the amount and frequency with which this article of food is eaten. The analyses of liver and shell-fish will be found in the tables on pages 157, 158.

The chief difficulty in computations of the nutritive value of meat and fish is due to the varying content of fat. Thus, the edible portion of chicken may contain on the average only 2.5 per cent. of fat, whereas lean ham may contain 14 per cent. of fat, fat ham as much as 50 per cent. and smoked bacon 65 per cent., though lean smoked bacon 42 per cent. In general a mixture of cooked lean meats probably contains not far from 10 to 15 per cent. of fat.

Fish differs from meat chiefly in the small quantity of fat. Even salmon, which contains more fat than most other fish, showed in its analysis only 12.8 per cent. fat, shad 9.5 per cent. and herring and mackerel 7.1 per cent. In general other kinds of fish show 6 per cent. or less of fat. Halibut steak, for example, contains 5.2 per cent. and cod 0.4 per cent. Preserved fish, however, is quite rich in fat; thus sardines contain 19.7 per cent. In substituting fish for meat, my patients are taught to add from $\frac{1}{2}$ to 1 teaspoonful of olive oil to the diet for each 30 grams of fish.

The quantity of protein in meat also varies considerably and usually falls as the percentage of fat rises. A value of 20 per cent. for protein in uncooked lean meat represents about the average, and this is increased to 25 per cent. or more when the meat is cooked. The quantity of protein in fish is very slightly less than that in meat. Fish is especially desirable in the early days of protein feeding following the preliminary carbohydrate-feeding days, because in fish the quantity of fat is so low. Shell-fish make agreeable additions to the diet: (1) they are desirable because they are palatable; (2) they are bulky foods and so are satisfying; (3) they furnish a separate course at a meal. Half a dozen oysters or clams are quite sufficient. The edible portion of a medium-sized oyster on the shell weighs on the average half an ounce, and half a dozen oysters would amount to

90 to 100 grams. The six would contain about 4 grams carbohydrate, 6 grams protein and 1 gram fat, the equivalent of 50 calories. Half a dozen clams on the shell (edible portion) weigh 35 grams and contain 0.7 gram carbohydrate, 3 grams protein and a negligible quantity of fat.

Eggs.—Next to meat and fish, eggs are the most frequent source of protein for the diabetic. (These have already been discussed on page 56.)

Cheese.—Cheese is a prolific source of protein and is to be recommended because of its lesser cost. A gram of protein in cheese is considerably less expensive than a gram of protein in the form of meat, fish or eggs. Unfortunately, most varieties of cheese upon the market contain large percentages of fat. Even skimmed-milk cheese may contain as much as 15 per cent.

Broths.—Broths are so extensively used on fasting days and as lunches for diabetic patients that their composition deserves notice. Jelly-like broth contains a large quantity of protein in the form of gelatin, and such broths may prevent diabetic patients from rapidly becoming sugar-free when they are consumed freely on otherwise fasting days. As a rule, the nutritive value of a broth made for diabetic patients should be negligible. That this may be the case, the broth should be skimmed free of fat, and obviously should be clear so as to be free from particles of meat fiber. Various canned bouillons and bouillon cubes contain very little nourishment. (See page 159.) The danger in broths lies in the amount of salt which they contain. Frequently this is very great, whereas the amount of salt should be moderate. Patients often desire to drink several cups of broth a day, and if the broth is heavily salted a portion of the salt may not be excreted. Each teaspoonful of salt that remains in the body holds back with it approximately one pint of water. This frequently causes temporary swelling of the lower extremities and face, a condition which is more annoying than dangerous.

Considerable variety can be obtained in the broths suitable for patients. These are described on page 146.

Fat in the Diabetic Diet.—Fat forms the bulk of the diabetic patients' diet. Even with the most modern ideas

upon treatment this statement holds. Fig. 11, and also Fig. 12, give the proportions which the different foodstuffs take in the diet and show the extent to which diabetic patients must depend upon fat to offset the loss of carbohydrate. Remember that the diet of a healthy individual of 70 kgs. at office work contains approximately 300 grams carbohydrate, yielding (300 x 4) 1200 calories. A diabetic patient of analogous size who failed to utilize more than 300 of these 1200 calories must replace the remaining 900 calories with 100 grams of fat. Theoretically this should be taken in addition to the usual 100 grams of fat in the normal ration; but practically this is seldom necessary, because the diabetic patient is usually less active than the ordinary individual. These calculations are made for a patient weighing 70 kilograms. In reality most diabetic patients weigh far less and therefore require less food.

The Eskimos live largely upon fat. Diabetic patients should be very thankful that there is a race of Eskimos through which proof is afforded that it is perfectly possible to maintain life on a diet in which carbohydrate is largely replaced by fat.

How much fat should a diabetic patient eat? This does not depend upon the capacity of the digestion. The safest answer would be: as little as possible in order to maintain body weight. Unquestionably the quantity will vary from time to time, and it may increase with years without detriment to the patient. Nevertheless, it is reassuring to see a diet which contains more carbohydrate than fat. In other words, a carbohydrate-fat ratio of 2 to 1 or 1 to 1, respectively, begets confidence and a carbohydrate-fat ratio of 1 to 5 or above causes apprehension. Yet case No. 664, with diabetes of fifteen years' duration, lives upon a diet which contains twice as much fat as carbohydrate, and for years the ratio was nearer 1 to 4 or even 1 to 5.

Fat is most agreeably taken as cream, and cream which contains 20 per cent. butter fat is usually easier to bear than a richer cream. The upper 120 c.c. (4 oz.) of a quart bottle of milk which has stood for twenty-four hours is 20 per cent. cream. It is seldom advisable to allow more than

half a pint (240 c.c.) of cream, although patients prefer to increase the quantity of cream at the expense of other forms of fat in the diet. Half a pint of 20 per cent. cream contains 48 grams of fat, and yet the quantity of carbohydrate or of protein in cream of this richness is but little over 8 grams, and may be estimated in clinical work as 8 grams, or 1 gram to the ounce. Occasionally patients tolerate butter better than cream, and, as a rule, fresh, unsalted butter is preferred. Obviously, when cream is increased in the diet the butter must be decreased, and *vice versa*. Thirty grams of butter contain 25 grams of fat, and this is a welcome addition to the diet. Oleo, butterine and nut margarine contain no sugar and have about the same percentage of fat as butter, and the cost is very much less. Lard being nearly 100 per cent. fat can be used to advantage more than it is now in the diabetic's diet. Crisco, also nearly 100 per cent. fat, is often more welcome than lard, because of the lack of flavor. Oil is 100 per cent. fat.

Oil is so desirable for a diabetic that it is inadvisable for a patient to take more than 15 grams (1 tablespoonful), lest he weary of the same. If oil is disliked upon vegetables it can be taken in small quantities as medicine after meals. Italian patients naturally bear olive oil unusually well. Olive oil forms an excellent lunch for diabetic patients. It may be used upon retiring. It is the diabetic patients' cough medicine and relieves the symptoms of his hyperacid stomach. Peanut, corn or cotton-seed oil may be substituted if expense is a factor. Mineral oil is without nutritive value.

Danger of Fat to the Diabetic.—Fat is the chief source of the dreaded acidosis, though to this in some degree protein contributes as well. Fat, therefore, at one time may preserve the life of the diabetic, because of its high nutritive value, but at another period may destroy it by causing acid poisoning. The close dependence of acidosis upon a fat diet is beautifully shown in Table 15, page 73.

There is no more potent agency in the prevention of acidosis than the withdrawal of fat from the diet. Allen has made us all his debtors by a series of experiments upon diabetic dogs which show the insidious way in which fat is harmful

in the manner in which it has been customarily employed in the treatment of diabetes. "Fat unbalanced by adequate quantities of other foods is a poison."

TABLE 15.—THE DEPENDENCE OF ACIDOSIS UPON THE FAT IN THE DIET (WILLIAMS AND DRESBACH).

Date.	Urine.			Diet.		
	Diacetic acid.	Total NH_3 (Folin), grams.	Total sugar (polar), grams.	Carbohydrate, grams.	Protein, grams.	Fat, grams.
1912						
July 5	++	1.9	48	20	100	200
6	++	2.1	27	65	100	200
27	+	0.6	30	90	33	74
Aug. 8	++	2.7	86	190	75	200
Oct. 20	+	0.6	45	64	75	30
31	0	0.3	38	45	75	30
Nov. 12	0	0.5	56	56	75	30
1913						
Jan. 28	+++	2.6	122	35	100	200
Feb. 2	+++	3.0	152	66	90	200
June 12	++++	4.1	108	90	100	200
July 27	++++	4.4	123	200	150	180+
31	++++	3.3	172	200	150	180+

Today an endeavor is already made to protect the patient from acid poisoning by limiting the quantity of fat to the amount that he can bear. In a routine way this is accomplished by decreasing the fat when there is any sign of acid poisoning, but eventually this will probably be more accurately accomplished by tests of the quantity of fat in the blood.

Alcohol.—The use of alcohol in diabetes would seem to be indicated, but, as a matter of fact, there is but a small percentage of my patients who employ it at all. 1 c.c. of pure alcohol yields 7 calories in its combustion. Thus, 15 c.c. (1 tablespoonful) of alcohol or its equivalent—30 c.c. (2 tablespoonfuls) of whisky, brandy, rum or gin—would yield 105 calories to the body. Seldom, however, do I prescribe it for patients, and this rule holds even for patients during days of fasting.

Most of the physicians of my acquaintance treat the vast majority of their patients without alcohol in any form.

Liquids.—It is rarely necessary to restrict the liquids in diabetes. The diminution of the carbohydrate in the diet with the resulting fall in the quantity of the sugar to be excreted usually leads to a corresponding diminution in the thirst and volume of urine. A doctor hesitates to restrict a patient with severe diabetes in the use of liquids for fear too little fluid will be available for the body with which to eliminate the acids which may have been formed. On the other hand, patients often upset the digestion by drinking large quantities of liquids rapidly. This is avoided by allowing only half a glass of water at a time, though the patient is instructed to take that as frequently as desired.

Case No. 1196 continually voided large quantities of urine, but investigation usually revealed a cause, such as the ingestion of 20 or more grams of salt, bouillon cubes in variable number or 21 half-grain saccharin tablets a day. Ice water should be discouraged; it may not always upset the digestion, but it does invariably call for the expenditure of calories to warm it to blood heat, and calories for such a purpose a diabetic cannot well spare.

Sodium Chloride.—Salt is of great service to the diabetic patient. If it is withdrawn from the diet the weight falls, due to the simultaneous excretion of water, and the skin and tissues of the patient are obviously dry.

In the early days of fasting treatment, patients often lost much weight because water alone was allowed. For example, one case lost thirteen pounds in four days in this manner. When broths are freely given during fasting it is not uncommon, particularly in the presence of acidosis, to see a patient gain weight, and invariably such patients feel better than those who lose.

This gain in weight is to be explained by the large quantity of salt in the broths. Salt is very freely used by diabetic patients. I do not remember to have ever seen a diabetic patient who took too little salt, though such a case has been called to my attention at another clinic. One of my fasting cases was accustomed to shake salt into his hand to eat.

Patients will often salt their broths, although these frequently already contain too much.

The fact that it is harmful for a diabetic patient to take large quantities of salt is occasionally shown by the excessive quantities of urine which they are obliged to void, though sugar-free, and by the swelling in legs and ankles which may appear. However, it should be stated that it is most exceptional for a patient with dropsy to develop diabetic coma, and I recall but one instance of a patient in diabetic coma in whom dropsy appeared. The withdrawal of salt from the diet of Case No. 1378 wrought surprising changes in her weight and her dropsy entirely disappeared. From 98 pounds it fell to 70 pounds in twenty-five days, and this was due almost exclusively to the disappearance of the dropsy. If the quantity of the urine in twenty-four hours does not exceed 1500 c.c. (3 pints) the amount of salt in the diet is seldom, if ever, too great.

CHAPTER IX.

THE DIETETIC TREATMENT OF DIABETES.

Introduction.—The purpose of the dietetic treatment of diabetes is to enable the patient by the rearrangement of his diet to lead a useful life. He may be urged to live less strenuously, but he can at least live in a manner similar to that of a healthy individual. This object is best obtained by preventing the loss of sugar in the urine, in other words, by keeping the urine sugar-free.

It is explained to the patient that whereas the sugar in the urine is chiefly dependent upon the sugar and starch in the diet, the simple reduction of the total quantity of the diet may result in its elimination; that this reduction of the total calorie value of the diet is most easily effected by giving up fats in all forms; that in order to determine how much of the balance of the diet, now consisting of carbohydrate (sugar and starch) and protein, is unassimilated and appears in the urine, certain articles of food should be selected whose composition is simple and well known; that the quantities of these foods taken in each twenty-four hours should be weighed or measured; that the facts so obtained should be reported to the physician, and finally, in order to show the result of the diet, a specimen of the urine saved from the twenty-four hour amount be sent for examination.

Until recently the urine furnished the best guide to the physician as to whether the patient was upon a proper diet. Today the examination of the blood affords information, which is of additional and, in some respects, of superior value. If the sugar in the blood can be maintained in the neighborhood of the normal quantity (0.10 per cent.), sugar does not appear in the urine save in exceptional cases. Usually sugar is not found in the urine until the blood sugar is increased to 0.17 per cent. Therefore, abnormalities are earlier apparent

in the blood than in the urine, and consequently if a patient has a normal blood sugar he knows he is in a safer condition than when he simply is informed that the urine is sugar-free. However, the knowledge of the blood sugar is recent and too categorical statements should not be made.

Treatment of mild cases of diabetes, like the treatment of all types of diabetes, can be carried out in various ways. There is no hard and fast rule. One of the simplest procedures, as suggested above, is to decrease the total quantity of the diet, irrespective of its quality, to such a poin as will bring about a slight loss of weight. Occasionally this is all that is necessary to free the urine from sugar. This is the explanation of the "milk cure" and "potato cure" of former times. Those exclusive diets were undernutrition diets. More commonly, however, impatience on the part of the doctor and patient defeats such a plan and the urine is first rendered sugar-free by the omission of such carbohydrate foods from the diet as sugar, sweetened desserts, bread or potato. While this treatment may work well in some cases, it leaves too much to chance to be successful in all. In certain instances it may even be harmful, because the omission of so much carbohydrate from the diet without simultaneous omission of fat may lead to acid poisoning, and acid poisoning is a serious handicap to a diabetic patient. The mere development of acid poisoning transfers the individual, at least temporarily, from the mild to one of the severe types of the disease. It is for these reasons that the following rather more laborious plan of dietetic treatment is recommended. No apology is offered for the added work entailed upon both doctor and patient, because during these first few weeks of treatment, foundations are being laid upon which years of usefulness and comfort can rest.

The patient is requested, for the sake of convenience, to select his diet from the following list of foods. He is cautioned to be moderate in all that he eats, and; for simplicity in weighing the food, to narrow his choice to a few articles.

Water, clear, thin broths, coffee, tea, cocoa shells or cracked cocoa (strained) may be taken as desired, and it is unnecessary to report the amounts of each.

TABLE 16.—ARTICLES FROM WHICH THE PRELIMINARY DIET OF A MILD DIABETIC CAN BE SELECTED.

Food.	Total quantity to be filled in by the patient and sent to the physician.
1. Orange (small)	Report in number.
2. Shredded Wheat	" pieces.
3. Milk	" cubic centimeters or ounces.
4. Fish	" grams or ounces.
5. Meat (lean)	" " "
6. 5 per cent. vegetables	" " "
7. Potato	" " "
8. Bread	" " "

Physicians and patients are often surprised that the urine has become sugar-free upon this diet, not realizing that it represents a great reduction in nutritive value, due to the exclusion of most of the fat. If the urine does not promptly become sugar-free upon it, a study of the diet list submitted will show the total quantity of carbohydrate and protein which it contains, and this compared with the sugar in the urine will indicate what further restriction or modification is necessary.

The plan as above described is intended only for those diabetics, presumably mild, who are about to begin treatment. However, it may be used by other diabetics as a test diet according to the following rule: Select from the above list of foods those which occur in your present diet and in the same quantities and eat nothing else.

Five cases will now be described to illustrate the treatment of diabetes under varying conditions. These five cases, A, B, C, D, E, represent types of diabetes from the very mild to the very severe. Instead of being described as five separate individuals they are described as an individual whose case has become steadily more serious because of lack of treatment. The data for urine and diet do not exactly correspond with actual cases which have been under my care, but the differences are slight. By choosing foods and figures which are easy for calculation the methods employed are more readily to be understood.

Test Diets with Illustrated Cases. Case A.—Mild Diabetes. Let us for illustration assume that a fat man in middle life, weight 90 kilograms (90 x 2.2 = 198 pounds), has just learned that the urine which he sent to his physician contained 1 per cent. of sugar. The volume of the urine amounts to 2000 c.c. (2 liters or 2 quarts and 2 ounces) and the total quantity of sugar (2000 x 0.01) is 20 grams, or $\frac{2}{3}$ of an ounce. He is given directions to live upon a diet in accordance with Table 16 and in two days again reports to his physician. The urine now amounts to 1500 c.c. and contains no sugar. The record of the diet which the patient brings, its values as computed in carbohydrate, protein and fat, is shown (Table 17) as Test Diet No. 1.

Table 17.—Test Diet No. 1.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Orange (small) . .	3 (300 grams pulp)	30	0	0
Shredded Wheat . .	1	23	3	0
Milk	480 c.c. (16 oz.)	24	16	16
Fish	120 gm. (4 oz.)	0	24	0
Meat	150 gm. (5 oz.)	0	40	25
5 per cent. vegetables[1]	300 gm. (10 oz.)	10	5	0
Potato	240 gm. (8 oz.)	48	8	0
Bread	180 gm. (6 oz.)	108	18	0
		243	114	41

The summaries show that, as a result of the simple request to limit the diet to a definite group of foods, the carbohydrates and fat have been reduced to about half the normal, whereas the protein remains the same. This is also evident from a study of the calories. A man of 90 kilograms, like Case A, requires for office work not far from 30 calories per kilogram or 2700 calories. This diet contains 1797 calories, or about 20 calories per kilogram body weight. The distribution of the calories among the various foodstuffs is as follows:

Carbohydrate	243 gm. × 4	= 972	calories.
Protein	114 gm. × 4	= 456	"
Fat	41 gm. × 9	= 369	"
	Total calories	= 1797	

[1] Consider each 30 gm. (1 oz.) of a mixture of 5 per cent. vegetables to contain 1 gm. carbohydrate.

Upon this such a patient would lose weight, but even if he lost 37 pounds—the average above normal of 320 of my cases of diabetes over thirty-nine years of age—his weight would conform to that of a normal individual 5 feet 8 inches high. Whether before this point was reached the carbohydrate or fat in the diet should be increased would depend in part upon the urine, the sugar and fat in the blood and upon such other factors as the mental attitude, the environment and the demands upon the individual in his daily work.

Case B.—Mild Diabetes. This case resembles in all essentials the individual described as Case A, but (1) the analysis of the first specimen of urine shows: volume, 2500 c.c.; sugar, 2 per cent.; total sugar, 50 grams. (2) After living for two days upon Diet No. 1 the urine does not become sugar-free, but the analysis is as follows: volume, 2000 c.c.; sugar, 1 per cent.; total sugar, 20 grams.

What is to be done? As stated above it is quite probable that persistence upon this diet with the consequent decrease in the weight of the patient would eventually result in the urine becoming sugar-free. More rapid results being desired, recourse is had to two expedients to bring this about, namely: (1) The further reduction of the total diet by the elimination of fat and (2) a sharp lowering of protein. The modifications of the diet necessary for this purpose are very simple, necessitating only the substitution of skimmed milk for milk, the replacement of meat by fish and the elimination of bread. To provide bulk as an offset to the bread, 5 per cent. vegetables are increased. The schedule would then be as follows:

Table 18.—Test Diet No. 2.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Orange (small) . .	3 (300 grams pulp)	30	0	0
Shredded wheat . .	1	23	3	0
Skimmed milk . .	480 c.c. (16 oz.)	24	16	0
Fish	300 gm. (10 oz.)	0	60	0
5 per cent. vegetables	480 gm. (16 oz.)	16	8	0
Potato	240 gm. (8 oz.)	48	8	0
		141	95	0

The calories in this diet are 944, or about 10 calories per kilogram body weight. They are distributed as follows:

Carbohydrate	141 gm.	× 4	=	564 calories.
Protein	95 gm.	× 4	=	380 "
Fat	0 gm.	× 4	=	0 "
			Total calories	944

After two days upon this diet the quantity of urine falls to 1500 c.c. and the sugar disappears.

The further course of Case B is to be regulated by the urine, the blood sugar and blood fat and the weight as in Case A. So soon as the blood sugar becomes normal (0.10 per cent.) fat could be added to the diet, very gradually at first and ultimately to such an extent that the total calories will not be in excess of 20 calories per kilogram for the body weight at the given time. When this point is reached the carbohydrate could be tentatively increased, preferably controlling each addition of 10 grams by a blood sugar test. Coincidently with this subsequent increase of carbohydrate the fat could be raised in the ratio of 0.5 gram fat for 1 gram carbohydrate. When the total calories reach 25 per kilogram body weight, additions to the diet should be exclusively as carbohydrate. If the total calories are near the point where sugar is to appear in the urine the critical figure is more quickly shown by increasing carbohydrate than the other foodstuffs, and it is always best to find out if one is near the danger-point. If sugar does appear in the urine, it is evidence that the patient either needs to lose more weight or that his case must be carried along upon a lower margin of carbohydrate.

Fat can be gradually increased in the diet in a very simple manner. Thus the substitution of 1 egg for 30 grams (1 ounce) of fish adds 6 grams of fat and leaves the protein unchanged; the substitution of 30 grams of meat for the same weight of fish adds 5 grams of fat and 2 grams of protein; the substitution of milk for skimmed milk adds 1 gram of fat for each 30 c.c. and the substitution of cream adds 6 grams fat for each 30 c.c. Bacon and butter will quickly raise the diet to the required figure, as is shown in Table 19, page 82.

TABLE 19.—TEST DIET NO. 2, MODIFICATION A.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Oranges (small) . .	3 (300 grams pulp)	30	0	0
Shredded Wheat . .	1	23	3	0
Milk	360 c.c. (12 oz.)	18	12	12
20 per cent. cream .	120 c.c. (4 oz.)	4	4	24
Eggs	2	0	12	12
Fish	90 gm. (3 oz.)	0	18	0
Meat	120 gm. (4 oz.)	0	32	20
Bacon	30 gm. (1 oz.)	0	5	15
5 per cent. vegetables	480 gm. (16 oz.)	16	8	0
Potato	240 gm. (8 oz.)	48	8	0
Butter	30 gm. (1 oz.)	0	0	25
		139	102	108

The calories in this diet are 1936. If the weight of the patient has fallen to 80 kilograms (176 pounds) this would amount to about 25 calories per kilogram body weight—a sufficient quantity for a man still fifteen pounds above the normal average for his age and height.

It is illustrative of the improvement in treatment that five years ago Case B would undoubtedly have fallen into the class of moderately severe diabetics. The next two cases about to be described, Cases C and D, unquestionably belong among the group of moderately severe diabetics. It is true that the tolerance of Case C for 100 grams carbohydrate would lead one to class him as mild if carbohydrate tolerance alone was the deciding factor. He is perhaps best described as mild because of modern treatment. Case D conforms to the type of a moderately severe diabetic rated by the standards of both yesterday and today. For the sake of uniformity and simplicity the originals of these Cases C and D, Cases Nos. 1563 and 1540 respectively, are described as the type Case A, but under different conditions, the features of the original cases being incorporated into the new histories.

CASE C.—Moderately Severe Diabetes. Let us suppose that our patient resembles in physical characteristics Case A. He has weighed 90 kilograms (198 pounds), and for his height was 16 kilograms (37 pounds) overweight. In February, 1917, he passed an examination for life insurance, but during the following June, 0.2 per cent. of sugar was

found in the urine upon one occasion and 0.4 per cent. upon another. This he neglected until one morning, two years later, he observes his collar is too large, thirst is present, the urine is increased and he remembers he was once told he had diabetes.

The twenty-four hour quantity of urine which he takes to his physician amounts to 3000 c.c. It contains 8 per cent. of sugar, making a total of 240 grams (one-half a pound). He is to some extent relieved when he hears there is no evidence of acid poisoning, and fortunately this does not make its appearance throughout the time he is under observation.

The blood fat is about 1.5 per cent. and the blood sugar 0.23 per cent. His body weight is now 80 kilograms, a loss from his former weight of 22 pounds. He is told to select his diet from the articles mentioned in Table 16. For convenience assume his selection was the same in quantity and quality as Case A, and is represented by Test Diet No. 1. But note the difference in the effect of this diet as shown by the examination of the urine at the end of two days! Whereas under the same conditions the urine of Case A was sugar-free, the urine of Case C amounts to 2500 c.c., contains 6 per cent. sugar, a total of 150 grams. Case C is at once placed upon Test Diet No. 2 for two days. The change of diet is immediately manifested in the urine. The analysis shows a volume of 2000 c.c. This contains 4 per cent. sugar, a total quantity in twenty-four hours of 80 grams. The result is gratifying so far as it goes, but obviously greater dietetic reductions must be made. Test Diet No. 3 is therefore prescribed for the next two-day period. The composition of Test Diet No. 3 is summarized in Table 20.

TABLE 20.—TEST DIET NO. 3.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Orange (small) . .	3 (300 grams pulp)	30	0	0
Shredded Wheat . .	1	23	3	0
Skimmed milk . .	120 c.c. (4 oz.)	6	4	0
Fish	150 gm. (5 oz.)	0	30	0
5 per cent. vegetables	480 gm. (16 oz.)	16	8	0
		75	45	0

The calories in this diet are 480, or 6 calories per kilogram body weight for a man of 80 kilograms. They are distributed as follows:

Carbohydrate	75 gm.	× 4	=	300 calories.
Protein	45 gm.	× 4	=	180 "
Fat	0 gm.	× 9	=	0 "
			Total calories	480

As the result of living upon this diet for two days the urine decreased to 1500 c.c., the percentage of sugar to 2 per cent., making a total output of 30 grams of sugar in twenty-four hours. The change in diet not being sufficiently effective, resort is at once had to Test Diet No. 4, shown in Table 21.

TABLE 21.—TEST DIET NO. 4.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Orange (small)	2 (260 grams pulp)	20	0	0
Skimmed milk	120 c.c. (4 oz.)	6	4	0
Fish	120 gm. (4 oz.)	0	24	0
5 per cent. vegetables	300 gm. (10 oz.)	10	5	0
		36	33	0

Carbohydrate	36 gm.	× 4	=	144 calories.
Protein	33 gm.	× 4	=	132 "
Fat	0 gm.	× 9	=	0 "
			Total calories	276

This diet cleared the urine of sugar. The blood sugar fell to 0.11 per cent., an approximately normal figure, but the blood fat remained high at 0.81 per cent., which is twice the normal. On this latter account no essential change was made in the diet during the next five days, save for the addition of carbohydrate, 10 grams. Thereafter the carbohydrate was increased about 5 grams a day, the protein somewhat less rapidly and the fat the least of all, so that on the fifteenth day after becoming sugar-free the diet was that represented in Test Diet No. 2, Modification B.

TABLE 22.—TEST DIET NO. 2, MODIFICATION B.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Oranges (small) . .	2 (200 grams pulp)	20	0	0
Shredded Wheat . .	1	23	3	0
Milk	240 c.c. (8 oz.)	12	8	8
Eggs	2	0	12	12
Meat	150 gm. (5 oz.)	0	40	25
5 per cent. vegetables	300 gm. (10 oz.)	10	5	0
10 per cent. vegetables	150 gm. (5 oz.)	10	3	0
Potato	150 gm. (5 oz.)	30	5	0
		105	76	45

Upon this diet the urine continued sugar-free, the blood sugar dropped to 0.09 per cent., but the blood fat remained the same 0.83 per cent. Subsequently, step by step, the diet will be increased but no attempt will be made to exceed that of Test Diet No. 2, Modification A, Table 19. More frequent examinations of the urine and blood also will be necessary than in the previous two cases.

A summary of the treatment of Case C is given in Table 23.

TABLE 23.—SUMMARY OF TREATMENT OF CASE C.

Time.	Urine.			Diet No.	Diet in grams.			Blood.	
	Volume.	Sugar.			Carbohydrate.	Protein.	Fat.	Sugar, per cent.	Fat, per cent.
		Per cent.	Total.						
1917									
June	...	0.4							
1919									
July	3000	8.0	240	Unrestricted					
2 days	2500	6.0	150	No. 1	243	114	41	0.23	1.5±
2 days	2000	4.0	80	No. 2	141	95	0		
2 days	1500	2.0	30	No. 3	75	45	0		
2 days	1500	0	0	No. 4	36	33	...	0.11	0.81
15 days later	1500	0	0	No. 2, Mod. B	105	78	45	0.09	0.83

Case D.—Moderately Severe Diabetes. This patient represents a slightly more severe type of diabetes than Case C. While resembling in weight and age Case C, the original from which the following description was drawn was a woman, the mother of six children. The youngest was seven years old in 1915, when the patient developed diabetes. At the first visit she is discouraged, her weight has fallen from 90 kilograms (198 pounds) in 1915 to 70 kilograms (154 pounds) in 1919. The urine is irritating, is estimated to be over 6000 c.c. and a single specimen contains 7.2 per cent. sugar. Fortunately there is no acid poisoning. Family cares seemed so compelling that she at once returned home and attempted to carry out treatment. It is not surprising that with the unavoidable distractions of her large household she did not become sugar-free, though under the care of a competent doctor and nurse. Test Diets Nos. 1, 2, 3, 4 were successively adopted and even fasting attempted, but sugar persisted in the urine. The patient then entered the hospital and was placed upon Test Diet No. 4: carbohydrate, 36 grams; protein, 33 grams. At the end of twelve hours the urine showed 2 per cent. sugar. Fasting was now begun and continued for three days. It proved successful, for at the end of this time the urine was sugar-free. Thereupon carbohydrate and protein were gradually increased and later fat in accordance with the diet shown in Table 24. It will not be necessary to describe the changes in the diet from day to day, as they are made plain by the table itself. The only new feature introduced is that the orange is given by weight. Oranges vary so much in size that when a patient has a low tolerance for sugar it is unwise to prescribe oranges except by weight.

During the period represented by the chart the urine remained sugar-free and the blood sugar dropped from 0.17 to 0.14 per cent. At discharge the diet prescribed contained carbohydrate 57 grams, protein 78 grams and fat 61 grams. The favorable course of this case like all those hitherto described is to be explained by the absence of acid poisoning both before and during treatment. How important this factor is the next case, Case E, will show.

TABLE 24.—CASE D. GRADUAL INCREASE IN DIET.

Date, 1919.	Diet in grams.				Dietary prescriptions in grams.						Blood sugar, per cent.
	Carbohydrate.	Protein.	Fat.	Calories.	5 per cent. vegetables.	Chicken.	Fish.	Milk.	Egg.	Orange.	
July											
6, 7, 8	0	0	0	0	..	..	..	..	..	..	0.17
9	5	3	0	32	150						
10	10	5	0	60	300						
11	15	8	0	92	450						
12	20	10	0	120	600						
13	20	18	3	179	600	30					
14	20	30	3	227	600	30	60				
15	20	46	9	345	600	90	60	..	..	..	0.14
16	25	49	9	377	750	90	60				
17	30	58	15	487	750	90	60	90	1		
18	33	66	26	630	750	90	60	150	2		
19	36	68	28	668	750	90	60	210	2		
20	39	69	29	693	750	90	60	240	2	20	

CASE E.—Severe Diabetes. The prototype of this case resembles Case A in all essential particulars save one, that the duration of the diabetes has been six years. He was sent to the New England Deaconess Hospital by his physician as a case of diabetic coma. Special interest attaches to this patient because upon examination at entrance the degree of acidosis (CO_2 in the alveolar air by the Fridericia method was 12 mm. of mercury and the CO_2 in the blood by the Van Slyke test reckoned in the same terms was 12.8) proved to be more severe than that of any other patient hitherto treated in this institution who has recovered and left the hospital alive. The weight had fallen to 60 kilograms (132 pounds).

He was at once placed upon a diet resembling Test Diet No. 3 and kept upon this for three days, and then upon a diet resembling Test Diet No. 4, upon which he remained two days. This was followed by a fast of four days. Thereupon he was fed for six days with Test Diet No. 5, which was essentially as shown in Table 25.

TABLE 25.—TEST DIET NO. 5.

Food.	Total quantity.	Carbohydrate.	Protein.	Fat.
Grape fruit . . .	100 gm. (3½ oz.)	5	0	0
Skimmed milk . .	90 c.c. (3 oz.)	5	3	0
Fish	60 gm. (2 oz.)	0	12	0
5 per cent. vegetables	300 gm. (10 oz.)	10	5	0
		20	20	0

With two days more of fasting the urine became sugar-free. The course of treatment up to this point and the subsequent increases in diet are shown in Table 26. At the end of six days, although sugar was absent, the patient was fasted again. He was eventually discharged from the hospital with a diet containing 1063 calories in the form of carbohydrate 26 grams, protein 80 grams and fat 71 grams.

TABLE 26.—COURSE OF CASE E.

No. of days.	Average daily excretion of sugar, gms.	Diet.	Diet in grams.			Carb. balance, grams.
			Carbohydrate.	Protein.	Fat.	
3	115	No. 3	75	45	0	−40
2	80	No. 4	36	33	0	−45
4	20	Fast	0	0	0	−20
6	30	No. 5	20	20	0	−10
2	2	Fast	0	0	0	− 2
1	0	—	2	15	9	+ 2
1	0	—	4	22	14	+ 4
1	0	—	6	31	18	+ 6
1	0	—	8	48	24	+ 8
1	0	—	9	61	24	+ 9
1	0	—	11	74	24	+11

The subsequent course of this case would be carried out in a manner similar to that described for Case D. Obviously the increase of the diet would proceed far more gradually.

For convenience Test Diets Nos. 1 to 5 are summarized in Table 27:

TABLE 27.—**Test Diets,** SERIES A, IN GRAMS OR CUBIC CENTIMETERS.

Food.	T. D. 1	T. D. 2	T. D. 3	T. D. 4	T. D. 5
Orange, very small, 3	300	300	300	200	
Grape fruit	...	...	...	...	100
Shredded Wheat, one	30	30	30		
Milk	480	480			
Skimmed milk	...	...	120	120	120
Fish	120	300	150	120	60
Meat	150				
5 per cent. vegetables	300	480	480	300	300
Potato	240	240			
Bread	180				
Carbohydrate	243	141	75	36	20
Protein	114	95	45	33	20
Fat	41	0	0	0	0

The test diets shown as Test Diets, Series B, begin with a lower quantity of carbohydrate. It is possible to employ this set of diets without the use of scales.

Test Diets, SERIES B, IN GRAMS OR CUBIC CENTIMETERS.

Food.	T. D. 1	T. D. 2	T. D. 3	T. D. 4	T. D. 5
Orange	300	300	300	200	50
5 per cent. vegetables	300	300	300	300	300
Skimmed milk	480	300	240	120	
Fish	120	180	90	90	
Potato	240	120	60		
Shredded Wheat, one	30	30			
Meat	90				
Bread	90				
Carbohydrate	189	102	64	36	15
Protein	89	58	33	27	5
Fat	15	0	0	0	0

If the patient is so unfortunate as not to have scales, treatment need not be abandoned, but the following approximate equivalents in place of weights may be employed:

Food.	Weight in grams.	Approximate equivalent.
Orange	300	One and one-half (large size)
5 per cent. vegetables	300	Three moderate portions
Skimmed milk	480	One pint (16 ounces)
Fish	120	Two small portions
Potato	240	Two medium-sized potatoes
Meat	90	One moderate portion
Bread	90	Three small slices

Description of Special Cases.—Case No. 804 assumes importance because he died a year and a half after he left the hospital in the eighth year of the disease. The advance in treatment since 1917 has been sufficient to warrant the belief that today his life could undoubtedly have been prolonged with comfort to himself. Evidence of the truth of this statement is to be found in the description of Case No. 564. At the time that Case No. 804 was discharged he was considered a successful patient.

Case No. 804 contracted diabetes at the age of forty-two years, and first consulted me four years later, December 17, 1914, at the age of forty-six. His weight at that time was 139. The quantity of sugar amounted to 5.6 per cent., and acid poisoning was present. With restriction of diet and fasting he became sugar-free on December 30 and the acid poisoning disappeared on January 7. He left the hospital sugar-free, having gained one pound by January 11, and a year later his weight was 150. Difficulty occurred in keeping sugar-free, and he returned for hospital treatment on April 22, 1917, showing in a twelve-hour specimen 2.5 per cent. (66 grams) of sugar and severe acid poisoning. In Table 28 it will be seen that even four days of fasting did not suffice to rid the urine of sugar. This was followed by three days of restricted diet, when the institution of one fast day made the urine sugar-free. On May 18 he left the hospital free from acid poisoning and sugar and weighing 134 pounds. His diet then contained carbohydrate 15 grams, protein 71 grams, fat 122 grams and alcohol 12 grams, making a total of 1526 calories. By August 17 he had been able to increase the diet to 50 grams carbohydrate, about 110 grams protein and 110 grams fat, making 1600 to 1800 calories in a day and the weight had risen to 148 pounds. From the above it can be seen that the diabetes changed from the severe to the moderate type and became at least temporarily mild. It is unfortunate that he was not under closer observation after leaving the hospital.

One of the most satisfactory cases of my series was Case No. 564, a boy of sixteen years, who in November, 1912, came to my former assistant, Dr. F. G. Brigham.

TABLE 28.—CASE NO. 804. A SEVERE CASE TREATED BY FASTING WHO SUBSEQUENTLY INCREASED HIS TOLERANCE FOR CARBOHYDRATE TO A REMARKABLE DEGREE.

Urine.			Diet in grams.						
	Sugar.								
Diacetic acid.	Per cent.	Total grams.	Carbohydrate.	Protein.	Fat.	Alcohol.	Calories.	Carbohydrate, balance grams.	Blood sugar per cent.
++++	2.8	—	—	—	—	—	—	—	
++	2.5	66	—	—	—	—	—	—	
++	1.3	35	0	0	0	0	0	−35	
++	0.8	14	0	0	0	0	0	−14	0.22
+	0.8	12	0	0	0	0	0	−12	
0	0.1	2	0	0	0	0	0	− 2	
0	0.1	3	0	30	6	9	237	− 3	
+	0.1	3	0	46	22	12	466	− 3	
0	0.2	6	0	51	37	12	621	− 6	
0	0	0	0	0	0	30	210	0	
+	−0.1	0	0	35	33	18	563	0	0.15
sl. +	−0.1	0	0	50	47	9	886	0	
sl. +	0.1	2	0	58	50	12	766	− 2	
sl. +	0	0	0	60	59	15	876	0	
sl. +	0	0	1	60	72	12	976	+ 1	
0	0	0	5	63	84	18	1154	+ 5	
0	0	0	9	63	92	9	1179	+ 9	
0	0.2	4	10	65	106	9	1317	+ 6	0.15
0	0	0	0	0	0	12	84	0	
0	0	0	9	63	94	12	1218	+ 9	
0	0	0	9	62	94	9	1193	+ 9	
0	0	0	9	62	91	3	1124	+ 9	
0	0	0	9	73	94	6	1216	+ 9	
0	0	0	9	68	91	9	1190	+11	0.10
0	0	0	11	70	106	12	1362	+13	
0	0	0	13	75	118	9	1477	+15	
0	0	0	15	71	122	12	1526	+15	
0	0	0	15	71	122	12	1526	+15	0.11
0	0	0	50	110	110	....	1630	+50	

Sugar had appeared in the urine without previous symptoms, following a football game between two large preparatory schools. The patient entered the New England Deaconess Hospital, where, under the methods of treatment adopted in 1912 and 1913, he remained from December 15, 1912, to January 14, 1913 without becoming sugar-free, the quantity of sugar varying between 3.4 per cent. (187 grams in the twenty-four hours) and 0.8 per cent. (43

grams in the twenty-four hours) at discharge. However, by persistence in the crude methods then employed, under the supervision of Dr. R. J. Thompson, of Fall River, and a nurse thoroughly versed in diabetic treatment, the acid poisoning which had been severe and later amounted to as much as is represented by 5.7 grams of ammonia in twenty-four hours, disappeared, and at his home he became sugar-free in April, 1913. He is now, 1919, in college.

In the spring of 1919 he reëntered the hospital under the care of Dr. B. H. Ragle, was treated according to present-day principles and ultimately discharged upon a diet of carbohydrate 41, protein 92 and fat 125 grams; weight naked, 108 pounds; blood sugar, 0.15 per cent.

Case No. 632, a young officer, aged thirty-five years, with diabetes of one and a half years' duration, came to me first in 1913. At the hospital diacetic acid showed repeatedly, and the ammonia was 1.7 grams, but the tolerance for carbohydrate lay between 15 and 30 grams. Nevertheless, he was discharged with 0.5 per cent. of sugar in the urine, and diacetic acid was present, with a diet of 30 grams carbohydrate and a limited quantity of protein, though with an unlimited amount of fat. He returned in February, 1916, and it required twelve days to free the urine of sugar and twenty-one days to rid it of acid, but he left the hospital April 13, having been sugar-free the preceding week, with a tolerance for 28 grams carbohydrate, 79 protein, 133 fat and 9 alcohol. The blood sugar was 0.21 per cent. While at the hospital exercise was utilized to the limit, and, as to be expected of an army man with a Victoria Cross, obedience was implicit, coöperation ever present and system exact. Permission has been obtained to publish this letter, received eleven months after leaving the hospital.

March 8, 1917.

"I have really been wonderfully well, feel splendid and everyone remarks how well I am looking. Tests have shown a slight trace of sugar on three mornings since October 8 last; all other times absolutely sugar-free. My weight doesn't change at all; if anything I have gotten very slightly lighter. I weigh from $124\frac{1}{2}$ to $125\frac{1}{2}$ pounds. I still stick

absolutely rigidly to my routine, but I have gotten up to 30 grams carbohydrate per diem—that is, on the last five days of the week I take 30—rest of diet the same. The last three weeks I have been taking 15 grams oatmeal for breakfast on Monday, Tuesday, Thursday, Friday and Saturday mornings, Wednesday all carbohydrate in 5 per cent. vegetables and cream and Sunday (fast day) all carbohydrate in 5 per cent. vegetables."

That this improvement continues is evident from another letter of October 12, 1917.

"We had a patriotic golf match here last Saturday and Monday against the rival golf club here. I was chosen to play 2d for the ———, and my opponent and I came out even in both our matches, one over our course and the other over the ———. I am sending you a newspaper clipping of the last game at ———, just to let you see that there is some life in the old dog yet. Since our game Mr. ——— won the club championship of the ———.

"I keep very well, as you may surmise from the above, sugar-free all the time. I stick to the same old routine—30 to 31 grams carbohydrate per diem. I gave up the orange, as I really prefer the 5 per cent. vegetables, and I thought that I took the vegetables better. I had a fine five days the end of September, up in the woods, trout-fishing; had good weather and very good fishing. I managed to keep sugar-free all the time, although I had a good appetite and took lots to eat."

February, 1918, the patient continued in good condition, sugar-free, with tolerance as before.

Explanation of the General Principles Underlying the Treatment of Moderately Severe and Severe Cases of Diabetes.—It has been shown that there are many means by which the urine of a diabetic patient may be freed from sugar, but the simplest of all is by fasting, and to this all other methods converge. If fasting for a day or two appears inadvisable, the simple omission of fat, which mate-

rially reduces the nutritive value of the diet, may render the patient sugar-free. Formerly, physicians endeavored to get their patients sugar-free by the reduction of carbohydrate in the diet, at the same time immediately increasing the fat and protein to make up for the calories thus lost. Various dangers attended this practice, and at present it is generally abandoned. The method now adopted to free the urine of sugar is designed to accomplish this end without any risk to the patient. It is brought about either by complete fasting or by the withdrawal of fat from the diet, and the subsequent reduction of carbohydrate and protein to a point at which the patient no longer voids sugar in the urine. Frequently both methods are combined, for it frequently happens that by the adoption of the plan about to be described under "Preparation for Fasting" that a patient becomes sugar-free within a few days and free from acid poisoning if that were present. By methods like the above alkalis are unnecessary, and, indeed, I believe if they are given that they do harm. In the following paragraphs in italics the plan is summarized:

Preparation for Fasting. — *In severe, long-standing, complicated, obese and elderly cases, as well as in all cases with acidosis, or in any case if desired, without otherwise changing habits or diet, omit fat, after two days decrease protein and halve the carbohydrate daily until the patient is taking 30 grams or less; then fast. In other cases begin fasting at once.*

Fasting.—*Fast four days, unless earlier sugar-free. Allow water freely, tea, coffee and thin, clear meat broths as desired.*

It is important for the patient to observe how his physician frees the urine from sugar in his particular case, because later if sugar should return he could follow the same plan by himself.

Table 29 shows how Case No. 938, a child, aged two years and four months, became sugar-free in two days with a moderately restricted diet for the first day and with fasting for the second day.

It will be observed that diacetic acid appeared October 26 and 27. In 1915 the necessity of completely omitting fat prior to fasting was not appreciated. With present methods

of treatment this appearance of diacetic acid would not occur, because during the last two years measures taken for the safety of the patient at the beginning of treatment have increased enormously.

TABLE 29.—CASE NO. 938. AGED TWO YEARS, FOUR MONTHS. ONSET SEPTEMBER, 1915.

Date.	Urine.		Diet.
	Diacetic acid.	Sugar, per cent.	
1915.			
October 25	0	7.6	Diet unrestricted.
October 25–26	0	3.2	Diet moderately restricted.
October 26–27	+	0	Fasting.

Case No. 979, a woman, aged forty-nine years, developed diabetes at the age of thirty-two. When she was first seen *seventeen years* later, January 26, 1916, she showed 7.4 per cent. of sugar and no diacetic acid. It is apparent from Table 30 how she became sugar-free without the development of acidosis by the elimination of fat and the restriction of protein, followed by the gradual diminution of carbohydrate.

TABLE 30.—CASE NO. 979, OF SEVENTEEN YEARS' DURATION, ILLUSTRATES (1) HOW PREPARATORY TREATMENT MAKES FASTING UNNECESSARY AND (2) RENDERS THE URINE SUGAR-FREE WITHOUT THE APPEARANCE OF ACID POISONING.

Date, 1916.	Urine.			Diet in grams.				Weight, pounds.	Dietary prescriptions in grams.							
	Diacetic acid.	Sugar.		Carbohydrate.	Protein.	Fat.	Calories.		Vegetables, 5 per cent.	Grape fruit.	Orange.	Potato.	Bread.	Apple.	Meat.	Oysters.	Fish.
		Per cent.	Total grams.														
Jan. 25	0	7.4															
25–26	0	6.2	54	..	..	..	..	130									
26–27	0	5.6	83	142	48	16	944	128	300	1	1.0	90	100	1	90	6	
27–28	0	4.0	70	112	43	16	764	128	300	1	1.0	90	50	1	90	6	
28–29	0	2.2	26	72	38	16	584	128	300	1	2.0	90	0	0	90	6	
29–30	0	1.0	14	50	28	11	411	127	300	1	1.0	30	0	0	60	6	
30–31	0	0.6	8	40	28	11	371	127	300	1	0.0	30	0	0	60	6	
Feb. 31– 1	0	0.2	2	25	26	5	249	126	300	0	0.5	30	0	0	20	6	40
1– 2	0	0.0	0	25	27	8	280	126	300	0	0.5	30	0	0	40	6	20
1917																	
Feb. 16	..	Trace	0														

Fasting.—Fasting is never so rigorous as doctors or patients expect. Patients are more ready to undergo it than physicians to prescribe it. Quite as often it is as much a relief to the patient as it is discomfort. This is in part due to the gradual decrease in thirst and frequent urination. Headache occurs less frequently than would be expected, and is usually dispelled by a cup of coffee. Nausea almost never occurs unless a patient is given alkali or alcohol. Children bear fasting more easily than adults. Case No. 899, with onset at eighty-three, shunned it and rightly, but she became sugar-free, and two years later was vigorous, remained sugar-free and actually able to eat apple pie and put sugar in her coffee without sugar occurring in the urine. It is always desirable to avoid fasting in the old, and this can be accomplished usually by the help of preparatory treatment. Fasting does not seem like fasting to the patients when they receive coffee, tea, cracked cocoa, cocoa shells and broths and are given an unlimited supply of water. Warm drinks are preferable. If the quantity of urine, as it often does, falls to less than normal the patients are urged to drink water freely. Clear meat broths are a great satisfaction. An analysis of the 1220 c.c. of broths taken by Case No. 765 during three days showed the total amount of calories therein contained to be negligible. Contrary to my experience with digestive cases, broths do not stimulate the appetite in fasting diabetics; they relieve it. The advantage of broths is probably due in part to this, but to a considerable extent to the patient receiving salt by which he may maintain the equilibrium of body fluid.

Patients need not be kept in bed during fasting, neither should they be forced to be up all day. Reclining in a steamer chair requires no more exertion than rest in bed. Remember what happens to an old man who is suddenly confined to bed and the discomfort which follows confinement after a fracture. Do not force a temperate man to drink against his will. Patients should be afforded diversion by brief visits from friends, walking short distances, easy handiwork, playing games, letter-writing and reading. In general, they are glad to rest for the greater part of the first day of

the fast, but upon each succeeding day they are usually desirous to increase the amount of exercise. An advantage which the omission of fat from the diet affords is the rest which is given to the digestive tract. Former treatment, which increased the fat in the diet, was the converse of this, and frequently led to vomiting, with the result that patients on the brink of coma fell into it. In every way seek to prevent worry on the patients' part, and from the start give them to understand that they are at a school rather than at a hospital.

Patients upon a low diet should be guarded from infections. If a nurse has a cold she should be relieved from duty, certainly from duty near diabetics. For this reason when on a low diet patients should keep out of street cars and shun congregations of people.

It is surprising how variable is the period required to render the urine sugar-free. Frequently a urine which contains 7 per cent. of sugar becomes free from sugar after fasting for four meals, and, conversely, a urine with only 3 per cent. of sugar may still retain traces after the patient has been deprived of food for three or four days. These are cases with high percentages of sugar or fat in the blood and cases of long duration who have been upon a diet with low carbohydrate and excessive quantities of fat. Cases presenting acidosis invariably require longer to become free from sugar. In general, cases seen soon after onset become sugar-free promptly, whereas the reverse is true for those of long duration, though the latter may do very well if they are free from acid poisoning. Case No. 733, age at onset seventeen years, was fasted twenty-six months later, when he showed 6.6 per cent. of sugar and became sugar-free in two days. The explanation in this instance was apparently the fact that the case was remarkably mild, being of the obesity type; in fact, the patient's highest weight—196 pounds—was reached when he first came under observation. During the preceding twenty-six months he had gained twenty-six pounds. Children showing large amounts of sugar have also become sugar-free very promptly when the duration has been only a few weeks. Cases of long standing

appear to become sugar-free more quickly with preparatory treatment than with an immediate fast. This is probably due to the avoidance of acidosis. Rarely is it necessary for a patient to fast more than a few days, and it is usually preferable, after four days of fasting, if the urine still contains sugar to feed the patient for two days and then fast again. The general rule which serves as a guide follows:

Intermittent Fasting.—*If glycosuria persists at the end of four days, give 1 gram protein or 0.5 gram carbohydrate per kilogram body weight for two days and then fast again for three days unless earlier sugar-free. If glycosuria remains, repeat and then fast for one or two days as necessary. If there is still sugar, give protein as before for four days, then fast one and then gradually increase the periods of feeding, one day each time, until fasting one day each week.*

Carbohydrate Tolerance.—Inspection of the various charts above cited will show that when the twenty-four hour quantity of urine has been free from sugar it is the custom to increase the carbohydrate, and this is usually done to the point at which sugar returns. In this way the tolerance of the patient for carbohydrate is determined. One rule is: *When the twenty-four hour urine is free from sugar, give 5 to 10 grams carbohydrate (150 to 300 grams of 5 per cent. vegetables) and continue to add 5 to 10 grams carbohydrate daily up to 50 grams or more until sugar appears, then fast until sugar-free.* The carbohydrate is generally given in the form of 5 per cent. vegetables, choosing those which are especially bulky. A plateful of lettuce appeals much more to the patient than a small saucer of string beans. When a mixture of 5 per cent. vegetables is given, one can be quite sure that the average content of carbohydrate is not more than 3 per cent., or approximately 5 grams for the 150 grams prescribed, and for convenience this is reckoned as 1 gram of carbohydrate for each 30 grams (1 ounce). This small amount of food, of course, has little nutritive value, but is enough to break the fast. Upon succeeding days, 5, 10 or even more grams of carbohydrate, varying with the severity of the case, are added daily until sugar returns or the approximate quantity

is reached which it appears probable the patient will tolerate. It should be borne in mind that a patient fasting or on a very low diet often shows an apparent tolerance for carbohydrate far in excess of that which he would have shown if the necessary protein and fat in his diet were simultaneously ingested.

Following the trial with 5 per cent. vegetables, one can proceed to the 10 per cent. group, and these can be empirically reckoned as containing 6 per cent. carbohydrate or approximately twice that of the 5 per cent. group, or 5 grams carbohydrate for 75 grams vegetables. From this point onward the addition of carbohydrate can be made according to the desire of the patient. The foods commonly employed in determining the tolerance for carbohydrate are: 5 per cent. vegetables, oranges, oatmeal, Shredded Wheat, milk or skimmed milk and potato. With children one often makes the mistake of increasing the carbohydrate too rapidly, forgetting the fact that 5 grams of carbohydrate to a child weighing 20 kilograms is in the same proportion as 15 grams of carbohydrate to an individual of 60 kilograms.

The increase in carbohydrate is also illustrated by Case No. 1209, Table 31, page 101, whose chart shows how sugar sometimes appears in the urine when if the doctor's advice had been followed it would have remained absent. This little boy ate candy, and although the quantity of sugar in his urine had fallen to 1 gram on January 3–4, it required two days of fasting following his use of candy for it to disappear. Later he broke rules again and fasting was necessary. Gradually he learned his lesson, at least temporarily, and left the hospital with a tolerance for 37 grams of carbohydrate and more calories than now would seem wise.

PROTEIN TOLERANCE.—*When the urine is again sugar-free decrease the carbohydrate by two-thirds below the carbohydrate tolerance, or at least 10 grams, and then add about 20 grams protein and thereafter 15 grams protein daily in the form of egg-white, fish or lean meat (chicken) until the patient is receiving from 1 gram protein to 1.5 grams protein per kilogram body weight.*

Thirty grams of fish or an egg of average size contain

approximately 6 grams of protein and 30 grams of lean meat contain approximately 8 grams. The white of an egg contains 3 grams of protein. By this arrangement a patient weighing 60 kilograms would be taking, within four days from the time he became sugar-free, 1 gram of protein per kilogram body weight. This quantity is quite satisfying to all except children—in fact, it is astonishing to me to find how few patients care to take as much as 1.5 grams of protein per kilogram body weight. Children, however, crave and need considerably more, and indeed take with avidity as much as 2 to 3 grams protein per kilogram body weight.

Fish is especially desirable in the early days of protein feeding because it contains so little fat. Cod, haddock, pike, skate, pollock, flounder and bass, for example, contain less than 1 per cent. Blue-fish contains 1.2 per cent., smelts 1.8, trout 2.1 and white fish and perch each 3 per cent.

The advantage of giving and increasing protein simultaneously with the determination of the carbohydrate tolerance is that one approaches more nearly normal conditions. What the physician is after is to determine the carbohydrate tolerance while the patient is on a full diet and not the tolerance for carbohydrate alone. On the other hand a higher carbohydrate tolerance can be attained when the addition of protein following the preliminary fasting is deferred until the actual carbohydrate tolerance is learned in the absence of protein and fat. Naturally the method adopted will vary somewhat with each patient. With patients who exhibit acidosis it is often preferable to defer the addition of protein until after the carbohydrate tolerance alone has been determined. The carbohydrate dispels the acidosis.

There are very few patients who will not bear at the outset as much as 1 gram of protein per kilogram body weight. It is unfortunate to allow the protein to remain permanently below this figure. This can be avoided by still further restricting the carbohydrate, either temporarily or permanently. It is always necessary to remember that one food which the diabetic patient cannot do without is protein, and to it everything else must be subordinated. More and more an effort should be made to spare body protein.

TABLE 31.—CHART OF A CHILD, CASE NO. 1209, AGED EIGHT YEARS AND SIX MONTHS, SHOWING HOW HE CONQUERED HIS TENDENCY TO EAT CANDY.

Date, 1917.	Urine.			Diet in grams.					Naked weight, pounds.	Dietary prescriptions in grams.										
	Diacetic acid.	Sugar.		Carbohydrate.	Protein.	Fat.	Alcohol.	Calories.		Vegetable 5 per cent., grams.	Oatmeal.	Fish.	Chicken.	Meat.	Egg.	Sugar-free milk, c.c.	Bacon.	Butter.	Cream 40 per cent., c.c.	Vegetable, 10 per cent.
		Per cent.	Total grams.																	
Jan. 1	0	9.0																		
1- 2	0	4.0	12	..	..	..	..	....	56											
2- 3	+	0.6	3	10	3	1	0	61	54	0	14									
3- 4	Tr.	0.1	1	10	2	0	0	48	..	300	0									
4- 5	0	3.1	**31**[1]	10	23	0	0	132	52	300	0	90								
5- 6	0	0.3	1	**0**	**0**	**0**	**0**	**0**	..	..	0	0								
6- 7	0	0	0	**0**	**0**	**0**	**0**	**0**	..	0	0	0								
7- 8	0	0.2	11	10	13	3	0	119	..	300	0	0	30							
8- 9	0	0	0	0	0	0	0	0	52	0	0	0	0							
9-10	0	0	0	10	17	12	0	216	..	300	0	0	0	0	1	90				
10-11	0	1.7	**13**[1]	15	26	18	0	326	..	450	0	0	0	0	2	90				
11-12	0	0	0	**0**	**0**	**0**	**0**	**0**	..	0	0	0	0	0	0	0				
12-13	0	0	0	15	26	18	0	326	54	450	0	0	0	0	2	90				
16-17	0	0	0	20	50	52	0	748	..	600	0	0	0	60	2	100	30	10		
17-18	0	0.1	0	20	59	67	0	919	..	600	0	0	0	90	2	120	30	20		
18-19	0	0	0	10	43	47	0	635	53	300	0	0	0	90	1	80	15	15		
22-27	0	0	0	31	67	92	0	1220	..	900	0	0	0	60	4	90	30	30	30	
27-28	0	0	0	37	63	98	0	1282	55	750	0	0	0	60	4	0	30	30	60	150

[1] Result of eating candy.

Fat Tolerance.—The studies of Professor Bloor and Dr. Gray in Boston and that of workers at various other laboratories has provided us with a reliable indicator for the tolerance of the patient for fat by means of the estimation of fat in the blood. As yet the test is too complicated for general use, but for those who have access to a laboratory it is perfectly practical. For those not in a position to employ Bloor's fat method there are indirect methods of determining fat tolerance, namely, signs of acidosis and the appearance of sugar in the urine (glycosuria) or an increase of sugar in the blood. So long as these exist the fat must be kept low. While testing the protein tolerance a small quantity of fat is included if, in addition to whites of eggs and lean fish, meat is given. Formerly this appeared advantageous, and such small quantities of fat certainly do no harm in the milder cases. In fact, the same rule holds for the testing of the carbohydrate and protein tolerance in the presence of fat as has been said for protein alone. There are, on the other hand, two important reasons why fat should not be given to the diabetic patient immediately upon his becoming sugar-free: (1) by the omission of fat, partial fasting is continued and thereby the patient is gaining a tolerance for carbohydrate, and (2) the continued omission of fat is beneficial in counteracting the last vestige of acid poisoning, or preventing the appearance of acid poisoning, which might easily occur in a diabetic patient whose metabolism has not become accustomed to so low a quantity of carbohydrate. But as soon as the patient has received the essential gram of protein per kilogram body weight and the blood sugar has reached normal the fat in the diet should be increased. If the patient is one in whom acidosis has been an essential factor, or if the patient is obese, the fat should be increased slowly, and for such a patient an increase of 5 to 10 grams a day may be all that he can take without the recurrence of a positive ferric chloride reaction in the urine. Cases which have shown little acidosis may easily be allowed an increase of 15 grams fat daily, and for such cases this is desirable, because it rapidly brings the total caloric value of the diet

up to a normal figure. Naturally, patients in whose treatment a loss of weight is desired would be given smaller quantities of fat.

A working rule is as follows:

Fat Tolerance.—It is usually desirable, especially in the young, to add no fat until the protein reaches 1 gram to 1.5 grams protein per kilogram body weight and the blood sugar is normal. Then add 5 to 25 grams daily, according to previous acidosis, until the patient ceases to lose weight or receives in the total diet 20 to 30 calories per kilogram body weight.

Reappearance of Sugar.—*The return of sugar demands fasting for twenty-four hours or until sugar-free. Resume the former diet, adding fat gradually, and last of all in order to maintain as high a carbohydrate tolerance as possible, sacrificing body weight for this purpose. This rule should be inflexibly followed, especially with children.*

In hospitals the above rule simplifies the treatment enormously. As soon as it is understood that the reappearance of sugar means a fast until sugar disappears from the twenty-four hour quantity of urine there is little tendency to break over the diet. Furthermore, most patients are thrifty enough to see the disadvantage of paying their board with no return. The rule must be rigidly enforced with children, because with them disobedience means death. When a patient has been made sugar-free by a preliminary fast, absence of food for twenty-four hours will almost invariably be sufficient to free the urine at once if the sugar returns. This will not be the case unless the presence of glucose is promptly detected and hence the necessity for the patient to examine his twenty-four hour urine daily. Following this accessory fasting day, the previous diet of the patient may be gradually resumed, making every endeavor to regain the former tolerance for carbohydrate by slowly increasing the quantity of fat. Great care should be exercised, more indeed than has been often taken, not to break down the tolerance a second time.

Months rather than weeks should intervene before the final amounts of carbohydrate, protein and fat, reached the second time, equal the quantity of carbohydrate, protein and fat eaten when sugar reappeared.

Patients often get into trouble by their failure to energetically grapple with the reappearance of sugar. One day of fasting will accomplish far more than many days of a moderately low diet. It is a mistake for any, save the most highly trained patients, to attempt to meet such a situation without medical advice.

Case No. 804, described on page 90, illustrates this well, for it is perfectly evident that he was an intelligent patient, and yet grew steadily worse until he returned for the second period of treatment at the hospital.

Another instance is Case No. 1279, who reached a tolerance in April, 1917, for 78 grams carbohydrate, 63 grams protein and 109 grams fat, with a blood sugar at this time of 0.12 per cent. In the autumn of the same year sugar repeatedly recurred and he was unable to become sugar-free at home. After a stay of a few weeks at the hospital he was discharged with a tolerance for 65 grams carbohydrate, 74 grams protein, 98 grams fat and blood sugar of 0.14 per cent.

Still another patient, Case No. 1265, shows the improvement of medical supervision. This patient, a woman, aged fifty-seven years, left the Corey Hill Hospital on May 5, 1917, with a tolerance for 30 grams carbohydrate, 58 grams protein and 119 grams fat, with a blood sugar under 0.10 per cent. Until the summer she did well, but in the early autumn, apparently finding the urine normal, she steadily increased her diet, yet her condition was not satisfactory to herself or her friends. Upon the return of her doctor he discovered that the Benedict solution she had been using was inaccurately made up and for over a month sugar had undoubtedly been present in the urine. Under hospital treatment she was discharged in two weeks, with a tolerance for 33 grams carbohydrate, 61 grams protein and 81 grams fat, with a blood sugar of 0.14 per cent.

Weekly Fast Days. — *Whether sugar reappears in the urine or not it is desirable upon one day each week to rest that function of the body which controls the assimilation of sugar by either a complete fast day or a diet of low caloric value.*

The following rule is suggested: Whenever the tolerance is less than 20 grams carbohydrate, fasting should be practised

one day in seven; when the tolerance is over 20 grams carbohydrate, cut the diet in half on one day each week ("half-day"). This is the revival of an old practice used many years ago, I understand, by Dr. Austin Flint, of New York, who kept in bed and fasted his diabetic patients on Sundays. Von Noorden terms such weekly fast days "Diabetic Sundays."

The benefit which the older clinicians derived from the use of one day's fast in seven in the treatment of their diabetic patients should ever be borne in mind. Case No. 1062, now under observation, who contracted diabetes twenty-six years ago, possibly in connection with gall-stones, tells me that at that period her physician, Dr. Randall, of Topsfield, Mass., often told her to go without food, save broths, for several days in succession, and that she was accustomed to follow this advice. Her severe symptoms of diabetes subsided at the end of four years. Recently the quantity of sugar has been slight. Her tolerance on June 1, 1916, reached 116 grams carbohydrate. The advantage of this restricted diet day each week is partly inherent in the fast or restricted diet, but to a considerable extent it is due to the attention of the patient being sharply called to his disease one day in seven, and the recollection which it awakens in his mind of his condition before treatment began and the difficulties which may have originally accompanied becoming sugar-free. Some exceptions to the above rules may be mentioned: for example, elderly patients bear fasting poorly, and when they remain sugar-free upon a rigid diet containing only 10 grams of carbohydrate it is my impression that it is better to simply restrict the calories of the diet one-half on one day each week rather than to institute an absolute fast. With such treatment these patients almost invariably gain in tolerance for carbohydrate. Children become fretful upon a fast day, though physically they endure it well. If they are allowed a few green vegetables in addition to broths they get along very comfortably. Von Noorden pointed out that the good effects of a fast day continued many days beyond the actual fast.

The Caloric Needs of the Patient.—The total number of calories which a diabetic requires varies not only with each

case, but varies with each case each day. Schematic rules do not hold. One must remember that an individual trained to be quiet, and while lying down can get along with only 20 calories per kilogram body weight reckoned per twenty-four hours, whereas the average of a large group of normal men and women at the Nutrition Laboratory, not especially trained for the test, consumed 25 calories per kilogram body weight reckoned also per twenty-four hours. If this variation exists while at rest, how much more it must exist during the various activities of different individuals. Furthermore, one must remember that the number of calories consumed per hour varies enormously. An individual weighing 60 kilos walking at the rate of four miles per hour would require an additional 193 calories for that hour over the resting metabolism. Habits of individuals vary widely. Some are quiet and some are active. All these considerations should be clearly borne in mind by doctors and patients in order not to allow themselves to be held too rigidly by any caloric fetish.

Special Dietetic Rules and Hints.—The responsibility for the management of the diet of a diabetic patient should always rest upon one individual. As a rule that individual is the patient, but at times another member of the household. Children who are above the age of ten years should be taught to plan their own diet. They readily learn to do this, and in so doing make their elders blush. In fact, it is more important for diabetic children to learn what and how much to eat than all the knowledge which their schools afford, for upon this information their life depends. Perhaps it is because this personal responsibility is so deeply felt in the management of little children that the treatment of diabetes in them proceeds so uniformly and always produces results so much better than are expected.

Patients should eat too little rather than too much. With a return to normal weight sugar may appear.

All food should be eaten slowly, and the coarser the food the more thoroughly it should be masticated.

If in doubt about a food, let it alone until you have found out whether it is allowed. Do not yield to the tempta-

tion of friends to break the diet, for if this is done the plan of treatment is upset, a week's time may be lost and several pounds of weight sacrificed. So-called diabetic foods often contain considerable quantities of carbohydrate, and usually contain so much protein and fat that they should not be taken by the patient without due allowance for the same. They should not be taken under any circumstances unless their composition is known. Be especially careful to note the effect of any increase in carbohydrate. The same rules hold for protein. The quantity of fat is regulated by many factors, among which are the presence or absence of acid poisoning, the sugar and fat in the blood and by the patient's weight.

The carbohydrate in the diet should be divided between the three meals. Even if the 10 per cent., 15 per cent. and 20 per cent. vegetables are allowed, vegetables from the 5 per cent. group should be taken as well. Usually it is allowable to substitute for a given quantity of 5 per cent. vegetables one-half as much from the 10 per cent. group, one-quarter as much from the 15 per cent. or one-sixth as much from the 20 per cent. Exchange vegetables for fruit only under advice. Remember it is always possible to get articles of food which are included in a strict diabetic diet for a few meals, such as eggs, meat, butter, oil and even 5 per cent. vegetables, fresh or canned. One of my cases who has done exceptionally well has a diabetic garden and thus provides liberally for his table both summer and winter. Quiet outdoor work agrees with diabetic patients.

In case of illness curtail the fat in the diet, and if acid poisoning is shown by the ferric chloride reaction, omit fat entirely.

CHAPTER X.

ACID INTOXICATION—ACIDOSIS—DIABETIC COMA.

Acid intoxication is the bugbear of doctor and patient. Formerly more than six of every ten diabetic patients succumbed to it; but now it is much less frequent. The acid intoxication (acid poisoning or technically termed acidosis) in diabetic patients differs in no respect from the acidosis which occasionally occurs in normal individuals when carbohydrate is omitted from the diet for three or four days. The ferric chloride (diacetic acid) reaction will then appear just as in a severe diabetic, and if at the same time the quantity of fat is increased a type of acidosis will be caused so severe as to threaten the life of the individual. When, however, the healthy body is gradually accustomed to live upon a diet low in carbohydrate, acidosis is avoided. The same course of events takes place in diabetes. In severe cases when all the carbohydrate of the diet appears in the urine as sugar the diabetic patient, although eating carbohydrate, is exactly like the normal individual deprived of his customary carbohydrate. If fat in undue quantities is given to a severe case of diabetes, under these circumstances diabetic coma may result. This did result when, years ago, we physicians, doing the best we knew, deprived patients of their carbohydrates in order to make them sugar-free, and at the same time, in order to enable them to maintain their weight, we markedly increased fat and protein to make up the calories omitted as carbohydrate. From what has already been written it can be seen how disastrous this was.

Today patients on beginning treatment are first of all deprived of fat, without other change in their dietary habits,

in order to take away the great danger of acid intoxication, and they subsequently are either made sugar-free by gradual reduction of carbohydrate and protein or simply by fasting. When the patient is sugar-free and one begins to increase the diet the fat is the food element to be added last of all.

Even when patients already showing acidosis come for treatment it usually disappears under the above plan. Should the acidosis be severe the following rules now in force for my cases at the New England Deaconess and Corey Hill Hospitals are suggested. It is desirable that all patients become familiar with these rules, and thus anxiety over acid poisoning will disappear. This plan of treatment seldom fails. (See Table 3, p. 24.) Indeed, since it has been established, as a routine method of procedure, worry about acid poisoning of patients has largely decreased, and evening visits to the hospitals can be eliminated.

RULES FOR THE TREATMENT OF SEVERE ACID INTOXICATION.

1. *Nursing.*—Provide a special nurse for the patient for both day and night, and preferably one trained in diabetic work.

2. *Bed.*—Keep the patient in bed and warm. Avoid loss of calories through exertion or exposure; if restless, protect from the cold by the use of flannel nightclothes. Every effort should be made to allay nervousness and discomfort.

3. *Care of the Bowels.*—Move the bowels by one or more enemata. Cathartics should usually be avoided for fear of causing diarrhea.

4. *Administration of Liquids.*—Give 1000 c.c. (1 quart) of liquids within each six hours. The liquids are to be given slowly, and hot. Use coffee, tea, thin broths, water; see also 5. If the prospect is dubious of giving so much liquid by mouth, salt solution or tap water is to be given by rectum; if this resource fails the nurse should call the doctor to give intravenously, or if that is impossible, subcutaneously, the balance of the liter which remains not given for the six-hour period. It will seldom be found necessary to give more than 1000 c.c. liquids, thanks to the avoidance of alkalis. In order

to secure the introduction of sufficient liquid in the first six hours the cleansing enema at the beginning of treatment should be followed after half an hour by an enema of 500 c.c. salt solution (one teaspoonful of salt in one pint of water) in all cases as a matter of precaution. The use of the duodenal tube may be helpful in introducing fluid.

5. *Diet.*—If the patient has been accustomed to the fasting method of treatment (*a*) begin or continue the fast, but (*b*) if he has been upon a full, unregulated diet omit the fat which it contained, but continue the approximate quantity of carbohydrate and protein of the preceding days. The carbohydrate should be given in a form easily tolerated by the stomach, such as carefully made gruels, orange juice, skimmed milk, shredded wheat or bread. Avoid an excess of coarse vegetables.[1] The patient should receive from 10 to 20 grams (1 to 4 teaspoonfuls) of salt daily.

6. *Stomach.*—If there is evidence of retained food in the stomach or of a dilated stomach the stomach should be emptied at once. The prompt recognition of such a state and its relief will undoubtedly save many lives. With adults when in doubt, but with children in all cases, begin treatment for threatened coma with gastric lavage.

7. *Heart.*—Sustain the circulation with the help of digitalis. Caffein may be given subcutaneously or as black coffee by the rectum in addition to coffee by the mouth.

8. *Alkalis.*—Avoid alkalis. If such have been previously given, omit at the rate of 30 grams a day.

[1] Test diets Nos. 3, 4 and 5 may be easily modified to meet these requirements. (See page 89.)

CHAPTER XI.

WEIGHT PECULIARITIES.

Most diabetic patients are obese prior to the onset of diabetes. As soon, however, as sugar begins to be lost in the urine the weight usually falls because the body is unable to utilize the food eaten. It is not uncommon for a patient to lose 50 pounds before treatment begins, and occasionally a patient will lose as much as 100 pounds during the course of years. A diabetic patient in reality is probably in safer condition if he is 10 to 20 per cent. below weight, because thus he can be assured that he is not overeating. In this respect it is better to emulate the Indian than the Eskimo. The individual 10 per cent. and even 20 per cent. below weight may not be a delight to our eyes, but if over thirty-five years of age and in this condition he is much more acceptable to the Insurance Company. It is often desirable for a patient to lose weight, but this should be undertaken only under the doctor's direction. Frequently it is only by losing weight that a patient regains the power to tolerate carbohydrate. As a guide to the proper weight for a diabetic the average weights of individuals for given heights and weights when dressed are given in Tables 33 to 37.

Changes in Weight during Treatment.—Diabetic patients are often surprised at the sudden change in weight which they undergo during a two weeks' course of treatment. Occasionally the weight goes up, but more often it falls. It may remain the same or even increase during several days of fasting. The reason for these changes is to be explained by the retention or discharge of water from the tissues. The following experiment conducted by me many years ago illustrates this well: A student was given a diet sufficient to maintain his body weight so far as nutritive

value was concerned, but from his food salt was entirely removed. As a result, in the course of thirteen days the weight fell 11.66 pounds. Upon the resumption of his former diet with salt as desired, 9 pounds of those lost were regained in three days. Diabetic patients often gain weight from exactly the same cause—namely, the ingestion of too much salt. Such gain in weight, however, should be looked upon at its real value, in other words, simply as a retention of fluid in the body.

Case No. 1378, showing considerable dropsy, lost weight as shown in Table 32. When the equivalent of the weight lost was weighed out in water it half-filled a pail, and when we realized that this had been carried about all day in the tissues of the patient, all of us were far more sympathetic toward the patient's disinclination to go up and down stairs.

TABLE 32.—CHART OF CASE NO. 1378. ILLUSTRATION OF DISAPPEARANCE OF DROPSY CO-EXISTENT WITH LOSS OF WEIGHT DUE TO A SALT-FREE DIET.

Date, 1917.	Urine.			Diet in grams.					Weight, lbs.
	Diacetic acid.	NaCl, grams.	Sugar total grams	Carbohydrate	Protein.	Fat.	Alcohol.	Calories.	
Sept. 13–14	0	—	0	3	20	6	....	146	89¼
23–24	0	4.9	6	17	50	42	50	996	98¾
Oct. 21–22	0	..	0	12	53	52	30	938	69½

Soon after entrance the salt in the diet was partially restricted, but evidently not enough to prevent increase in weight, as the chart shows (see September 23–24). From this point onward the salt was excluded with the greatest care from the diet, and the weight uniformly fell. It is noteworthy that this patient a year previously, some thousands of miles from Boston, had been given during a period of six months enemata of 8 quarts of salt and soda daily. Furthermore, she was then in the habit of taking beef tea loaded with salt, and each week consumed one and a half pounds of salted almonds, as well as using salt freely in her food.

TABLE 33.—HEIGHTS AND WEIGHTS OF CHILDREN BETWEEN ONE AND FOUR YEARS OF AGE (WITHOUT CLOTHES).

5602 boys			4821 girls	
Height, inches.	Weight, pounds.	Age, months.	Height, inches.	Weight, pounds.
26.5	18.0	6	25.9	16.8
27.3	19.1	7	26.5	17.4
27.6	19.8	8	27.0	18.3
28.1	20.4	9	27.6	19.1
28.5	20.9	10	27.9	19.5
29.0	21.4	11	28.4	20.1
29.4	21.9	12	28.9	20.8
29.9	22.9	13	29.4	21.0
30.3	23.0	14	29.5	21.6
30.8	23.6	15	30.1	21.9
31.1	24.1	16	30.5	22.6
31.4	24.5	17	30.8	22.9
31.8	24.6	18	31.1	23.4
32.3	25.5	19	31.5	23.8
32.6	25.8	20	32.0	24.1
32.9	25.8	21	32.3	24.8
33.3	26.9	22	32.6	25.3
33.6	27.0	23	32.9	25.6
33.8	27.1	24	33.4	26.4
34.0	27.9	25	33.8	26.9
34.1	28.3	26	33.9	27.3
34.8	29.0	27	33.9	27.3
35.1	29.1	28	34.6	27.8
35.4	29.3	29	34.8	27.8
35.4	29.5	30	34.9	28.3
35.5	30.5	31	35.1	28.8
36.0	30.6	32	35.4	29.0
36.1	30.6	33	35.6	29.1
36.5	31.1	34	36.5	30.1
36.8	31.9	35	36.5	30.3
37.1	32.3	36	36.8	30.5
37.4	32.3	37	36.8	30.8
37.5	32.4	38	37.0	31.0
37.9	33.1	39	37.3	31.6
38.5	33.5	40	37.5	32.0
38.6	33.6	41	37.8	32.3
38.6	33.8	42	38.0	32.5
38.8	33.8	43	38.3	32.8
38.9	34.3	44	38.5	33.0
39.0	34.5	45	38.5	33.5
39.0	34.8	46	38.8	33.5
39.3	35.8	47	38.9	33.5
39.5	35.9	48	39.0	33.8

Crum, F. S.: Quarterly Publication of the American Statistical Association, Boston, September, 1916, N. S., No. 115, xv, 332–336.

TABLE 34.—HEIGHTS AND WEIGHTS OF BOYS BETWEEN FIVE TO FOURTEEN YEARS (WITHOUT CLOTHES).

BOYS

Weight in Pounds	Without Clothes
Height in Feet and Inches	Without Shoes

AGE	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	4	4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	5	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	6	6-1
5	35	38	39	41	42	46																													
6		36	39	41	42	44	43	48																											
7					42	43	46	48	49	51																									
8							45	48	50	53	54	57	59																						
9									50	53	55	58	60	62	62	65																		
10									55	55	58	60	62	65	68	69	71																	
11													61	64	65	68	71	77	77	78														
12													63	67	70	75	78	79	84	84	85													
13														67	71	75	78	80	85	86	91	98	94	100										
14														67	71	76	79	82	86	90	91	97	103	107	114	122								
15																	79	82	87	91	95	99	106	112	118	119	121	128	133					
16																					99	99	104	112	120	122	125	129	133	134	140			
17																						104	110	117	122	125	128	130	136	140	140			
18																							115	120	120	128	131	136	139	143	146			
19																								120	126	129	134	136	139	146	149	149		
20																									125	130	132	139	139	145	148	154	155	

Metropolitan Life Insurance Company.

TABLE 35.—HEIGHTS AND WEIGHTS OF GIRLS BETWEEN FIVE TO FOURTEEN YEARS (WITHOUT CLOTHES).

GIRLS

Weight in Pounds	Without Clothes
Height in Feet and Inches	Without Shoes

AGE	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	4	4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	5-0	5-1	5-2	5-3	5-4	5-5
5	34	37	38	41	41	45																					
6		35	37	39	41	43	45	48																			
7				39	42	44	45	47	50																		
8						42	45	47	49	51	53	56															
9								48	51	53	56	59	63														
10										54	57	58	62	64	63												
11													60	62	63	68	70	75									
12														65	66	69	71	75	78	83	88	94					
13														65	68	73	76	80	86	89	94	99	104				
14																	78	83	88	93	98	103	104	107	112	114	
15																				89	97	103	102	106	109	112	118
16																					100	104	109	111	116	116	121
17																						109	109	110	110	117	125
18																						105	108	107	112	114	120
19																						99	105	111	113	119	123
20																						99	111	111	114	115	123

Mutual Life Insurance Company.

TABLE 36.—HEIGHTS AND WEIGHTS OF 221,819 MEN OF FIFTEEN OR MORE YEARS OF AGE (WITH CLOTHES).

Age.	Graded average weight in pounds with clothes.																	
	Feet and inches with shoes.																	
	5–0	5–1	5–2	5–3	5–4	5–5	5–6	5–7	5–8	5–9	5–10	5–11	6–0	6–1	6–2	6–3	6–4	6–5
15	107	109	112	115	118	122	126	130	134	138	142	147	152	157	162	167	172	177
16	109	111	114	117	120	124	128	132	136	140	144	149	154	159	164	169	174	179
17	111	113	116	119	122	126	130	134	138	142	146	151	156	161	166	171	176	181
18	113	115	118	121	124	128	132	136	140	144	148	153	158	163	168	173	178	183
19	115	117	120	123	126	130	134	138	142	146	150	155	160	165	170	175	180	185
20	117	119	122	125	128	132	136	140	144	148	152	156	161	166	171	176	181	186
21	118	120	123	126	130	134	138	141	145	149	153	157	162	167	172	177	182	187
22	119	121	124	127	131	135	139	142	146	150	154	158	163	168	173	178	183	188
23	120	122	125	128	132	136	140	143	147	151	155	159	164	169	175	180	185	190
24	121	123	126	129	133	137	141	144	148	152	156	160	165	171	177	182	187	192
25	122	124	126	129	133	137	141	145	149	153	157	162	167	173	179	184	189	194
26	123	125	127	130	134	138	142	146	150	154	158	163	168	174	180	186	191	196
27	124	126	128	131	134	138	142	146	150	154	158	163	169	175	181	187	192	197
28	125	127	129	132	135	139	143	147	151	155	159	164	170	176	182	188	193	198
29	126	128	130	133	136	140	144	148	152	156	160	165	171	177	183	189	194	199
30	126	128	130	133	136	140	144	148	152	156	161	166	172	178	184	190	196	201
31	127	129	131	134	137	141	145	149	153	157	162	167	173	179	185	191	197	202
32	127	129	131	134	137	141	145	149	154	158	163	168	174	180	186	192	198	203
33	127	129	131	134	137	141	145	149	154	159	164	169	175	181	187	193	199	204
34	128	130	132	135	138	142	146	150	155	160	165	170	176	182	188	194	200	206
35	128	130	132	135	138	142	146	150	155	160	165	170	176	182	189	195	201	207
36	129	131	133	136	139	143	147	151	156	161	166	171	177	183	190	196	202	208
37	129	131	133	136	140	144	148	152	157	162	167	172	178	184	191	197	203	209
38	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	198	104	210
39	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	199	205	211
40	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	206	212
41	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	207	213
42	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
43	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
44	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
45	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
46	134	136	138	141	144	148	152	156	161	166	171	177	183	189	196	203	210	216
47	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
48	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
49	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
50	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
51	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
52	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
53	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
54	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219
55	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219

Association of Life Insurance Directors and Actuarial Society of America, New York, 1912, pp. 38 and 67. Published by a committee. Allow one inch for shoes and ten pounds for clothes.

TABLE 37.—HEIGHTS AND WEIGHTS OF 136,504 WOMEN OF FIFTEEN OR MORE YEARS OF AGE (WITH CLOTHES).

Graded average weight in pounds with clothes.

Age.	Feet and inches with shoes.																
	4–8	4–9	4–10	4–11	5–0	5–1	5–2	5–3	5–4	5–5	5–6	5–7	5–8	5–9	5–10	5–11	6–0
15	101	103	105	106	107	109	112	115	118	122	126	130	134	138	142	147	152
16	102	104	106	108	109	111	114	117	120	124	128	132	136	139	143	148	153
17	103	105	107	109	111	113	116	119	122	125	129	133	137	140	144	149	154
18	104	106	108	110	112	114	117	120	123	126	130	134	138	141	145	150	155
19	105	107	109	111	113	115	118	121	124	127	131	135	139	142	146	151	155
20	106	108	110	112	114	116	119	122	125	128	132	136	140	143	147	151	156
21	107	109	111	113	115	117	120	123	126	129	133	137	141	144	148	152	156
22	107	109	111	113	115	117	120	123	126	129	133	137	141	145	149	153	157
23	108	110	112	114	116	118	121	124	127	130	134	138	142	146	150	153	157
24	109	111	113	115	117	119	121	124	127	130	134	138	142	146	150	154	158
25	109	111	113	115	117	119	121	124	128	131	135	139	143	147	151	154	158
26	110	112	114	116	118	120	122	125	128	131	135	139	143	147	151	155	159
27	110	112	114	116	118	120	122	125	129	132	136	140	144	148	152	155	159
28	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
29	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
30	112	114	116	118	120	122	124	127	131	134	138	142	146	150	154	157	161
31	113	115	117	119	121	123	125	128	132	135	139	143	147	151	154	157	161
32	113	115	117	119	121	123	125	128	132	136	140	144	148	152	155	158	162
33	114	116	118	120	122	124	126	129	133	137	141	145	149	153	156	159	162
34	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
35	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
36	116	118	120	122	124	126	128	131	135	139	143	147	151	155	158	161	164
37	116	118	120	122	124	126	129	132	136	140	144	148	152	156	159	162	165
38	117	119	121	123	125	127	130	133	137	141	145	149	153	157	160	163	166
39	118	120	122	124	126	128	131	134	138	142	146	150	154	158	161	164	167
40	119	121	123	125	127	129	132	135	138	142	146	150	154	158	161	164	167
41	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	165	168
42	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	166	169
43	121	123	125	127	129	131	134	137	140	144	148	152	156	160	163	167	170
44	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
45	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
46	123	125	127	129	131	133	136	139	142	146	150	154	158	162	165	169	172
47	123	125	127	129	131	133	136	139	142	146	151	155	159	163	166	170	173
48	124	126	128	130	132	134	137	140	143	147	152	156	160	164	167	171	174
49	124	126	128	130	132	134	137	140	143	147	152	156	161	165	168	172	175
50	125	127	129	131	133	135	138	141	144	148	152	156	161	165	169	173	176
51	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
52	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
53	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
54	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177
55	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177

Association Life Insurance Directors and Actuarial Society of America, New York, 1912, pp. 38 and 67. Published by a committee. Allow one and a half inches for shoes and six pounds for clothes.

It is also interesting that although the carbohydrate in an individual's diet is replaced by an equivalent number of calories in the form of fat, the weight promptly falls, and if the reverse procedure is adopted the weight will rise. The loss or gain of weight which occurs under such conditions may amount to two pounds in a day for several days. Finally, there is a real reason for a loss of weight during the treatment of diabetes, due to the fact that the diet is often deficient in calories. Against this loss we must fight!

The foregoing height and weight tables (Tables 33 to 37 inclusive) were selected by Dr. Horace Gray as the most satisfactory in the literature.

CHAPTER XII.

THE DIABETIC DIET IS EXPENSIVE.

This is true whether the patient is untreated or treated, but in the former state the waste of food is enormous.

Case No. 1171, before treatment was begun, told me that he ate thirteen eggs for breakfast, not by any means as a stunt, but because he wanted them. Case No. 1147, a lady of thirty-five years of age, ate a dozen eggs a day, and in response to my request gave me a report of her daily diet before she began treatment. This is shown in Table 37. It will be observed, however, that the carbohydrate was below normal—good evidence, therefore, that her diet had already been somewhat altered from the normal before the time at which she reported; in fact, I think her diet was originally considerably in excess of that recorded.

Table 38.—Estimated Diet of a Woman of Thirty-five Years, Case No. 1147, Prior to Treatment. Weight, Seventy-two Kilograms.

Food for twenty-four hours.	Quantity.	Carbohydrate, grams.	Protein, grams.	Fat, grams.
Eggs	12	0	72	72
Five per cent. vegetables	450 grams.	15	8	0
Milk	2000 c.c.	96	64	64
Forty per cent. cream	240 c.c.	8	8	96
Butter	90 grams.	0	0	75
Meat	120 grams.	0	32	20
Bread	100 grams.	60	10	0
	Totals	179	194	327
		4	4	9
	Total calories	716	776	2943

Total calories 4435 ÷ 72 kilograms = approximately 60 calories per kilogram body weight.

Although the diet contained 60 calories per kilogram body weight instead of the normal 30 calories, the patient, while

upon it, lost 66 pounds in a little over two and a half years. The reason for this was apparent, for on October 6, 1916, the volume of the urine was estimated at 6000 c.c. (6 quarts) and the sugar was found to be 5 per cent., or 300 grams (10 ounces), the equivalent of a loss of 1200 calories in the urine in twenty-four hours. In one year this would amount to 240 pounds of sugar! After a two weeks' stay in the hospital she felt more content with a diet of 1600 calories—a trifle less than her body needs—than when upon the 4400 calories at entrance.

It is obvious that the saving of food which results from becoming sugar-free under modern treatment must be considerable. It is the diet of the untreated diabetic which is expensive, since the large excess is far worse than wasted.

Case No. 295 voided in twenty-four hours, on October 23–24, 1909, approximately 10 liters of urine (nearly 20 pounds), containing 680 grams of sugar, the equivalent of 2720 calories! The weight of this patient was 50 kilos. In other words, he lost in the urine 54 calories per kilo, an amount sufficient in calories to supply almost double his own needs if taken in the form of food which he could assimilate. He must have eaten as much as three men of his own size.

Diabetic patients with acid poisoning lose calories in the urine not only in the form of sugar but as acid bodies as well. The quantity of acid bodies thus lost is quite considerable. These acid bodies represent wasted food just as much as does the sugar in the urine. Case No. 344 is a good illustration of this. On December 25–26, 1911, he excreted 188 grams sugar, the equivalent of (188 × 4) 752 calories, and in addition 55 grams acid bodies, equivalent to (55 × 5) 275 calories. Acid intoxication is really a dreadful robber, for besides stealing the food of a patient, it frequently steals his life!

The diet of the treated diabetic is also expensive. In comparing the diet of the diabetic patients with those of the non-diabetic patients at the New England Deaconess Hospital, Miss Dike and Miss Wallace found that the diabetic diet was 26 per cent. more expensive. The diabetic

FIG. 13.—SUGAR, MEASURED AS LUMP SUGAR, LOST IN THE URINE BY UNTREATED DIABETIC PATIENTS.

Case No. 295	Case No. 1147	Case No. 653
A Severe Diabetic	A Moderate Diabetic	A Mild Diabetic
680 grams a day	300 grams a day	174 grams a day
546 pounds (1½ barrels) a year	240 pounds (⅔ barrel) a year	140 pounds (⅖ barrel) a year

The number of diabetic patients in the United States is not far from half a million. If diabetic patients in the United States were kept sugar-free there would be from 5 to 10 pounds of additional food, measured in the form of sugar, for each man, woman and child in the country. Stated in another way, this is the equivalent ot five to ten days' rations for each inhabitant.

patient cannot subsist on cheap carbohydrate foods such as cereals, bread and potatoes, but must replace these with expensive varieties such as eggs, meat, broths and fresh vegetables. In addition to the cost of the raw materials the labor entailed in the preparation is a factor of considerable importance.

The diabetic who must save expense could attain his object if he used tea and cocoa shells instead of coffee and cracked cocoa, gelatin and agar-agar sparingly or not at all, substitutes for butter instead of bacon and cream, the cheaper kinds of vegetables, whether fresh or canned, and of meat and fish, and finally omit broth. The home canning of vegetables in diabetic families should be encouraged. A garden is a great advantage.

CHAPTER XIII.

CARE OF THE TEETH.

Many diabetics have sound teeth, thus showing that diabetes is not necessarily productive of bad teeth. On the other hand the teeth should always be kept in good condition, for it is common to have the diabetes grow worse in the presence of inflammatory conditions about the teeth, and gums. The teeth should be cleaned after each meal and it is desirable to have them cleaned by a dentist at least every three months. If the teeth are to be extracted, novocain injected cautiously acts admirably. If necessary, gas or gas and oxygen may be employed, but ether and chloroform are to be avoided for fear of bringing on acid poisoning.

The care of the teeth is of enough importance to warrant the insertion of the following abstract of a dentist's leaflet, which supplies specific instruction on this subject.

Clean Teeth Will Not Decay.

How can all the food be removed from all the surfaces of all the teeth after each meal?

1. By brushing.
2. By using floss silk between the teeth.
3. By thoroughly rinsing the mouth with lime water.

Rules for Brushing the Teeth.—1. Brush four times a day:

Before breakfast, with clear water.

After each meal, with a tooth paste or powder.

The teeth must be clean and free from food before going to bed, as most of the decay takes place while sleeping.

2. Brush two minutes each time. If, however, the teeth are kept well polished by the dentist a lessened brushing time will suffice. This depends upon the individual case.

It takes two minutes of brushing to properly stimulate the gums and thoroughly cleanse the teeth. Be sure and brush the gums.

3. Do not use pressure with the brush. A fast, light stroke is the best. A brush should never be worn out by having its bristles flattened and spread out.
4. Candies, sugar, crackers, cake, pastries, bread will make the teeth decay if allowed to remain on their surfaces.

Floss Silk.—Four-fifths of the decay of teeth takes place on the surfaces between the teeth and one-fifth on the surfaces on which one chews. There is but one way which is effective in removing the food from between the teeth, and that is with a piece of floss silk.

Use a section of floss about twelve inches long. Hold one end between the thumb and first finger of the left hand and wrap the floss twice around the end of the first finger. Do the same with the thumb and first finger of the right hand. Now by using combinations of the ends of the thumbs and second fingers the floss may be carried into the mouth and forced carefully between all the teeth. Rub it back and forth against the surfaces of each tooth to loosen and remove the food and to clean these surfaces. After a little practice one can floss all the surfaces between the teeth in a minute's time.

There still remains on the surfaces of the teeth, especially between them, a glue-like deposit known as mucin. This mucin must be removed, as it allows the bacteria to cling to these surfaces. The most effective and harmless solvent to use as a mouth wash is lime water. In fact if but one thing could be used to prevent decay of the teeth, lime water used three times daily would prove to be the most valuable.

Preparation of Lime Water.—Secure coarse, unslaked lime and crush it into a fine powder. Place a half-cupful in an empty quart bottle and fill nearly full with cold water. Thoroughly shake and then allow the lime to settle to the bottom of the bottle, which will take several hours. Avoid injury to furniture from heat generated in the bottle. After the lime has settled pour off as much of the clear water as possible without losing any of the lime, as this first mixing

contains the washing of the lime. Again fill with cold water, shake well and allow it again to settle.

Into an empty twelve-ounce bottle pour the clear lime water, taking care not to stir up the lime in the bottom of the bottle. Again fill the quart bottle with cold water, shake thoroughly and set it aside to use when the smaller bottle becomes empty. This process may be repeated until the half-cup of lime has made five or six quarts of mouth wash.

The twelve-ounce bottle is used, as it is more easily handled at the wash bowl. After brushing and flossing the teeth, pour out a little of the lime water in a glass and taking it in the mouth force it back and forth between the teeth with the tongue and cheeks until it foams. If you rinse it long enough to make it foam it has then been in the mouth long enough to have a beneficial action on the teeth. After spitting it out rinse the mouth with clear water to take away the taste of the lime. If the lime water is a little strong at first, dilute it with clear water in the small bottle, half and half. It should be used clear and full strength as soon as the gums become hard and healthy from brushing.

CHAPTER XIV.

CARE OF THE SKIN.

The skin must be kept unusually clean. Take a tub bath daily, but avoid prolonged cold baths. Short cold baths are often desirable. A certain boy took his cold morning bath in four seconds; adults often go to the other extreme in point of time and thus lose the good effect.

Protect the Skin from Injuries.—If any infection occurs see a physician at once. Infections of the skin are apparently less common now than formerly, and this may be attributed to cleanliness. Such infections are and should be rare in diabetic patients under treatment. They demand immediate, thorough, yet gentle treatment. One of the first duties of a physician is to tell diabetic patients to keep the skin clean and to report the beginning of an infection at once. Patients should be warned of the danger from slight wounds, should be specifically advised not to allow manicurists or chiropodists to draw a drop of blood and cautioned to promptly report any injury to the skin. A neglected sore on a toe has cost many a diabetic his leg and not a few their lives. If such a condition is reported to the physician and the patient stays in bed from the start, healing can readily take place.

Absolute cleanliness of the body is essential. Subcutaneous injections, whether of water, salt solution or drugs, may be harmful, but with modern asepsis perhaps can be safely employed. It is common for salt solution or solutions of sodium bicarbonate, when injected subpectorally, to result in abscess. If there is the slightest tendency to furunculosis my custom is at once to adopt simple measures analogous to those described by Bowen.[1] The patient is

[1] Bowen: Jour. Am. Med. Assn., 1910, lv, 209; Boston Med. and Surg. Jour., 1917, clxxvi, 96.

advised to wash the whole body twice a day with soap and water, using a wash-cloth or piece of flannel, and to dry the skin without rubbing, so as to avoid breaking open any pustule; the whole body is then bathed with a saturated solution of boracic acid in water, with the addition of a small proportion of camphor water and glycerin. A solution of 2 parts alcohol and 1 part water has often worked to advantage, but Bowen in his second paper still prefers the boracic acid. Individual furuncles may be treated with the following ointment, according to Bowen:

Boracic acid	4
Precipitated sulphur	4
Carbolated petrolatum	30

One should be careful, however, not to overtreat the skin. Harm may result from frequent dressings. The simplest lotions should always be employed. In severe cases the patient should be put to bed, all linen changed twice daily, and the patient treated in as aseptic a way as possible. In a few cases vaccines have appeared to be of marked benefit. "This procedure, thorough bathing and soaping, the application of the borated solution, and the dressing of the individual furuncles, is repeated, as has been said, morning and night. A further point of vital importance relates to the clothing that is worn next the skin. Every stitch of linen worn next to the skin should be changed daily, and in the case of extensive furunculosis all the bedclothing that touches the individual, as well as the nightclothing, should be subjected to a daily change. Naturally, this treatment must be *continued for several weeks after the last evidence of pyogenic infection has appeared*, and this fact must be emphasized to the patient at the outset." (Bowen.)

CHAPTER XV.

TREATMENT OF CONSTIPATION AND DIARRHEA.

The bowels should move daily. To this end nothing compares in effectiveness with the cultivation of regular habits and hours for this purpose. Time is required and half an hour or even more at the same time of the day for three successive days will often bring relief from constipation and this will persist for months. The coarse vegetables and fruit of the diet may prove quite sufficient, but if necessary bran muffins made with agar-agar (see page 137) may be employed. If potatoes are included in the diet the baked potato skins may solve the difficulty. Never purge the bowels, but depend upon an enema or upon simple laxatives, such as aloin, grain $\frac{1}{5}$; fluid extract of cascara sagrada 10 to 30 drops; extract cascara sagrada 5 grains or compound rhubarb pills.

If the patient has not had a movement for several days, at the beginning of treatment give an enema followed by some simple cathartic or mild aperient, and another enema twelve to twenty-four hours later; but do not purge the patient. Gain enough is obtained if a movement is produced once in twenty-four hours when it has only been taking place once in seventy-two. In other words, do not upset any patient who is in a tolerable state.

The following exercises for constipation were recommended to me by Mr. Gustaf Sundelius:

Home Exercises for Constipation.

1. *Abdominal Kneading and Stroking.—Kneading.*—Lying down, with knees slightly drawn up. Place hands one on top of the other on the abdomen at the right groin; with

small circular movements and deep pressure work upward until the ribs are met, then across toward left, following the boundary line of the chest, then downward to the left groin. Repeat twenty to fifty times. *Stroking.* With hands similarly placed, make long, steady and deep strokes, following the same route. Repeat twenty-five to one hundred times.

2. *Leg-rolling.*—Lying down, take hold of both legs just below the knees, press the knees up close to the abdomen, then carry them apart, then down and inward until they meet again, thus letting the knees describe two circles. Repeat ten to twenty times.

3. *Abdominal Compression.*—Standing against the wall with hands clasped behind neck, draw the abdomen forcibly in, using the abdominal muscles, hold a second, then let go. Repeat ten to forty times.

4. *Trunk-rolling.*—Standing with hands on hips, feet apart and legs well stretched, roll the upper body in a circle on the hips by bending forward, to the left, backward, and to the right. Then reverse, and repeat six to twelve times each way.

Case No. 559 warded off constipation by sawing wood, and Case No. 265 regulated his bowels by eating a slice of raw cabbage for breakfast.

The reverse of constipation, diarrhea, is rare in diabetes. When it occurs the patient should immediately go to bed, keep warm and live upon hot water, and in exceptional cases upon boiled, skimmed milk. The bowels should be cleared with an enema, and if there is any suggestion of undigested food remaining in the stomach this should be removed by lavage or induction of vomiting. The physician may administer an opiate. Rest in bed is the essential and the best sort of treatment. The diet should be gradually resumed, adding the coarse vegetables last. The few days of restricted quantities of food may be of real help to the patient.

CHAPTER XVI.

DRUGS IN THE TREATMENT OF DIABETES.

Drugs are not recommended by physicians like Professor Naunyn, the Nestor of diabetic treatment, or by those concerned in the recent advance in diabetic treatment in this country.

Drugs are not prescribed with the purpose of lowering the sugar in the urine in the most famous of our large hospitals. Drugs, however, are often useful to relieve special symptoms. Theocin and diuretin will often remove an obstinate edema within two days.

On the other hand, drugs are frequently recommended by those who have proprietary preparations to sell.

CHAPTER XVII.

DIETETIC SUGGESTIONS, RECIPES AND MENUS.

The narrow confines of the diabetic diet have greatly stimulated the manufacture of so-called diabetic foods. These are often serviceable, but are to be employed with discretion. Their use should be discouraged at the beginning of treatment. The patient should never become dependent upon special diabetic foods, for they are often unobtainable, always make him conspicuous, and when he acquires a disgust for foods of this class it is all the harder to abide by the original diet. When the patient buys one of these foods, unfortunately he is often given a list of other diabetic foods and a new diabetic diet list, and confusion in the diet may result. The patients under my care who have done best either never use special diabetic foods or only a few varieties.

Substitutes for Bread.—Many of the preparations upon the market contain as great or even a greater quantity of carbohydrate than ordinary bread; a few contain less; but the percentage of carbohydrate may vary from time to time. Patients, and sometimes physicians, forget that substitutes for bread must be prescribed only in definite amounts. A diabetic bread should never be prescribed without a knowledge of its content of carbohydrate, protein and fat.

The bread of one of the largest bakeries in Boston, upon analysis, showed 55 per cent. carbohydrate. Bread made without milk or sugar, but with water and butter, contains 45 to 50 per cent. carbohydrate. Such a bread is undoubtedly superior to many different bread substitutes upon the market. The percentage of carbohydrate in toast is greater than in plain bread, because it contains less water. Some of the coarser kinds of bread, such as rye bread, graham bread, black bread and pumpernickel, contain somewhat less

carbohydrate. Never give bread substitutes early in treatment. Teach patients to live without them.

Bran Bread.—Bran is being more and more employed in the diet of diabetic patients. This is neither more nor less than the use of cellulose, and this is supposed to have no effect upon the metabolism. Unfortunately, the availability of the protein, fat and carbohydrate of wheat bran to the diabetic patient has not been determined, although there are plenty of data upon its digestibility by ruminant animals. Bread made of bran alone is not very palatable, though with the fat of bacon or butter it is liked better. It furnishes bulk and acts favorably upon constipation. If made with eggs and butter the flavor is improved. It should be remembered that bran often contains a considerable quantity of starch. For this reason bran biscuits often prove to be a delusion and a snare, and one dreads to see them on a patient's tray. In large hospitals where diabetic patients are constantly being treated the danger is less, for the bran is bought by the same person and at the same place; but in private practice this is different. In purchasing bran go to a feed store and ask for coarse bran for cattle and not for bran for the table. The various preparations of bran, bran breads and cookies sold under trade names often contain carbohydrate other than bran, hence the reason for their agreeable taste; beware of them! They may contain over 60 per cent. carbohydrate, of which less than 10 per cent is real bran. Mild diabetics get into little trouble with bran, but the serious ones often suffer. The starch may be washed out with water by tying the bran in a cheesecloth, soaking one hour in running water by fastening the same on a faucet. It should be thoroughly mixed and kneaded from time to time to be sure the water reaches all portions, and should be washed until the water comes away *clear*. This may require an hour.[1]

[1] Four preliminary analyses of washed bran showed the following percentages of starch: 0.6, 1.8, 2.7, 5.2 per cent. Two preliminary analyses showed pentosan 29.8, 33.5. The wide variations in the percentages of starch will account for the occasional occurrence of sugar in the urine following the use of bran cakes.

Gluten Breads.—These breads are made by removing the sugar-forming material from the flour. It is surprising how thoroughly this can be done. The large quantity of protein in small bulk which they contain is objectionable.

Light Breads.—French bread cut in thin slices is often useful, because it is bulky and gives the appearance of a large quantity. Manufacturers have taken advantage of this idea and many light breads are on the market. These breads often contain about the same quantity of carbohydrate as ordinary bread, though a few contain considerably less. Their virtue often consists solely in their bulk, which allows a surface on which to spread butter. I seldom advise breads. It is better for the patient to forget the taste.

Various other substances have been used for flour in the manufacture of bread. Thus, aleuronat meal has been employed, and with it have been mixed various vegetable products. A group of casein breads is upon the market in the form of casoid flour under various names, and to some diabetics these are valuable.

Soy bean is also extensively used and probably deserves a still wider introduction into the diabetic diet. The carbohydrate in it is unassimilable. It is also used in the manufacture of flour. Agar-agar may be used to dilute the flour or to add to bran and also to relieve the constipation of the diabetic, which is frequently troublesome.

Substitutes for Milk.—A few tablespoonfuls of cream are a great comfort to a diabetic patient. Except in cases with a very low tolerance a gill (120 c.c.) of 20 per cent. cream can generally be allowed, and if it is desirable to give more fat without increasing carbohydrate and protein a gill of 40 per cent. cream is also well borne. Formerly patients took half a pint of 40 per cent. cream readily. With severe cases it is seldom possible to allow more than 60 to 90 c.c. of 20 per cent. cream, for the balance of the fat which can be safely employed can more advantageously be taken in meat, butter, oil and cheese. On the other hand, fat having been removed, the chief value of the milk to the diabetic patient is lost. The percentage of sugar in sour milk is not much

less than in fresh milk. Recently, sugar-free milks[1] have been put upon the market on a large scale, and many of my patients, particularly children, have found them of distinct advantage. These preparations of diabetic milk will keep from one to three weeks, and are consequently of great value to patients when travelling. As a rule they are concentrated one-half. Consequently they should be diluted before being used. They are so valuable for diabetic patients that one should always encourage their use in small quantities at first, so that the patient can become accustomed to the artificial taste and can determine the form in which the milk is most agreeable to him. This is often as equal parts of milk and Vichy Célestin.

Williamson[2] suggested the following rule for the manufacture of artificial milk: "To about a pint of water, placed in a large drinking pot or tall vessel, three or four tablespoonfuls of fresh cream are added and well mixed. The mixture is allowed to stand from twelve to twenty-four hours, when most of the fatty matter of the cream floats to the top; it can be skimmed off with a teaspoon easily, and upon examination it will be found practically free from sugar. This fatty matter thus separated is placed in a glass." The white of an egg is added to it and the mixture well stirred. Then dilute with water until a liquid is obtained which has the exact color and consistency of ordinary milk. "If a little salt and a trace of saccharin be added a palatable drink, practically free from milk-sugar, is produced which has almost the same taste as milk, and which contains a large amount of fatty material. With very little practice the right proportions can be easily guessed, and of course much larger quantities can be employed (in order to prepare a considerable amount of the drink at one time) than those mentioned above."

Rennet may be made from milk, but unless the curd is carefully washed it will contain 2 to 2.5 per cent. lactose. When the rennet is made from cream the lactose is materially diminished. Kefir contains approximately 2.4 per cent.

[1] D. Whiting & Sons, Boston.

[2] Williamson: Diabetes Mellitus and its Treatment, Macmillan Company, 1898, p. 334.

milk-sugar. Von Noorden says this milk has also been of great help in the treatment of diabetes in children.

Lawrence Litchfield, of Pittsburgh, gives whipped cream to his patients made according to the following rule: Add two ounces of 40 per cent. cream to a pint of cold water in a Mason jar and have it shaken vigorously until the cream is thoroughly "whipped." Sometimes a trace of saccharin is added, usually not. "My patients like to eat this with a spoon, but, of course, it can be used in any way that is desired. It contains only a trace of sugar." The fermented milks contain about half as much carbohydrate as ordinary milk.

RECIPES.

Many books have been written containing recipes for diabetic patients. With modern methods of treatment, however, most of these rules are worthless for severe diabetic patients because of their high content of protein and fat.[1] In general such patients prefer and should be encouraged to take simple, natural foods rather than artificial ones.

The mild cases of diabetes need no special recipes. Desserts can often be made with gelatin, and this may be flavored with coffee, lemon, rhubarb, cocoa shells or cracked cocoa. In preparing such desserts, if saccharin, is used it should be added as late as possible during the cooking, for it is apt to become bitter with heat. It is always a safe rule to add too little rather than too much saccharin. Usually one need pay little attention to the quantity of protein in the gelatin, because the ordinary portion of jelly contains only about 2.5 grams. One of my patients on a very rigid diet so enjoyed the bulk of the gelatin as to take 10 grams daily. She accomplished this by having the jelly made very thick.

DIABETIC BREAD OR BISCUITS.

1 Box Lister's Diabetic Flour
3 Eggs

Method.—Separate whites and yolks of eggs. Add to whites salt to taste. Beat whites until very thick. Beat

[1] The patient must invariably allow in the total diet for the quantities of carbohydrate, protein and fat which he has had in any given recipe.

yolks until thick and lemon colored. Combine and beat with egg-beater. Fold in gradually one box of Lister's Diabetic Flour. Bake in tin 5 inches long, 3 inches wide and 3 inches high (straight sides). Have oven hot. If baked in gas-stove oven, bake for fifteen minutes, full heat, then reduce heat one-half for ten minutes longer. If baked in coal or wood oven, bake from fifteen to thirty minutes. Do not remove from tin until partly cooled. Each loaf contains protein, 58 grams; fat, 18.6 grams; calories, 397. If desired this may be made into biscuits. The bread or biscuits may be flavored with nutmeg or cloves.[1]

DIABETIC NOODLES.

METHOD.—To the well-beaten yolks of two eggs, add two tablespoonfuls of warm water and a little salt. Slowly stir in one box of Lister's Diabetic Flour. Knead and roll on pie-board. When almost dry, roll and cut fine. Dry thoroughly.

DIABETIC MUFFINS.

1 Box Lister's Diabetic Flour
1 Egg
3 Tablespoonfuls of sweet heavy cream (40 per cent. cream)
2 Tablespoonfuls of bacon fat

Same quantity of butter, melted lard or Crisco may be used in place of bacon fat. This will make eight muffins, each muffin having food value equivalent to one egg (or protein, 6 grams; fat, 6 grams; calories, 78).

METHOD.—Beat white of egg very stiff; beat yolk separately from white; to the beaten yolk add the cream and beat; then add bacon fat (butter, melted lard or melted Crisco); beat again, then add the beaten white of egg; lastly the flour, beating the mixture all the while the flour is slowly added. Put in buttered, hot muffin irons and bake for ten to twenty minutes. If coal range is used, bake for fifteen minutes and have the oven hot. Use old-fashioned cast-iron muffin iron.

[1] Clove, mustard, cayenne are free from starch. White pepper, cinnamon and ginger contain much starch.

LISTER'S FLOUR AND BRAN MUFFINS.

(Useful in Diabetic Constipation.)

1 Level tablespoonful lard, bacon fat, butter or Crisco
1 Egg
1 Cupful washed bran
1 Package Lister's Flour
⅓ Cupful water or less

Tie dry bran in cheesecloth and soak one hour. Wash by squeezing water through and through. Change water several times; wring dry. Separate egg and beat thoroughly. Add to the egg yolk the melted lard and beaten egg white. Add Lister's Flour, washed bran and water. Make nine muffins.

DIABETIC COOKIES.

1 Box Lister's Diabetic Flour
1 Egg
3 Tablespoonfuls of cream
3 Tablespoonfuls of butter or bacon fat

METHOD.—Beat egg until light. Add cream and beat again. Add butter and beat again. Then add Lister's Flour slowly. A little caraway seed, ginger or vanilla may be added to suit the taste. Roll very thin and only a small amount at a time. Bake in hot oven about ten minutes.

Makes thirty cookies of about 23 calories each.

FRENCH TOAST.

1 Egg
2 or 3 tablespoonfuls cream
Lister's Muffins, Biscuits or Bread

Beat the egg and cream together. Slice Lister's Muffins, Biscuits or Bread. Soak the slices in the egg and cream and fry in a little hot butter until light brown.

Follow all directions exactly as given. The batter may appear to be too thick or heavy, but no more moisture should be added than is called for in these directions.

BAKED SOY BEANS.

Yellow Soy beans, 120 grams, are soaked for forty-eight hours, then boiled for about half an hour and finally baked with 30 grams pork for twelve hours. The food value is approximately as follows:

	Carbohydrate, grams.	Protein, grams.	Fat, grams
Soy beans, 120 grams	0	48	24
Pork, 30 grams	0	4	12
Baked Soy Beans and Pork	0	52	36

SEA MOSS.

Sea moss farina and Irish moss are usually allowable for diabetic patients. Most of the carbohydrate in these materials is in the form of pentosans and galactans, which Swartz[1] has shown to be quite inert in the body. Unfortunately these products are sometimes adulterated with other carbohydrates. This emphasizes the fact that no matter how useful a food may be in itself, one must always be on the lookout for adulteration.

HEPCO CAKES.

So arranged that one cake is equivalent to an egg.

	Protein.	Fat.
Hepco flour, 140 grams	60	29
Eggs (2)	12	12
Cream, 40 per cent., 60 c.c.	2	24
Butter, 10 grams	..	9
	74	74

Make twelve cakes. Each cake contains 6 grams protein, 6 grams fat and approximately 75 calories.

BRAN BISCUITS FOR CONSTIPATION.

The following rule was given me by Dr. F. M. Allen:

Bran	60 grams
Salt	¼ teaspoonful
Agar-agar, powdered	6 grams
Cold water	100 c.c. (½ glass)

[1] Swartz: Tr. Conn. Acad. Arts and Sc., 1911, xvi, p. 247.

Tie bran (for character of bran to purchase see p. 131) in cheesecloth and wash under cold water tap until water is clear. Bring agar-agar and water (100 c.c.) to the boiling-point. Add to washed bran the salt and agar-agar solution (hot). Mold into two cakes. Place in pan on oiled paper and let stand half an hour; then, when firm and cool, bake in moderate oven thirty to forty minutes.

The bran muffins naturally will be far more palatable if butter and eggs are added. This may be done providing the patient allows for this in the diet. If the patient is not upon a measured diet, then considerable latitude can be employed in making the bran cakes.

NEW ENGLAND DEACONESS HOSPITAL RECIPE.

Bran	100 grams
Powdered agar-agar	20 "
Pinch of salt.	

Tie bran loosely in a piece of cheesecloth and soak twelve hours. Wash until clear; add dry agar-agar and salt. Pack firmly into muffin pans oiled with mineral oil. Bake three-quarters of an hour or more in a slow oven.

BRAN CAKES FOR DIABETICS.

Food.	Amount.	Protein, grams.	Fat, grams.	Carbohydrate, grams.	Calories.
Bran	2 cupfuls				
Melted butter	30 grams	..	25	..	225
Eggs (whole) 2	....	12	12	..	156
Egg white (1)	25 grams	3	..	..	12
Salt	1 teaspoonful				
Water.		—	—	—	—
		15	37	0	393

Tie bran in cheesecloth and wash thoroughly by fastening on to the water tap until the water comes away clear. The bran should be frequently kneaded so that all parts come in contact with the water. Wring dry. Mix bran, well-beaten whole eggs, butter and salt. Beat the egg white very stiff and fold in at the last. Shape with knife and tablespoon into

three dozen small cakes. If desired one-half gram of cinnamon or other flavoring may be added. Each cake contains: protein, 0.5 gram; fat, 1 gram; calories, 11.

CRACKED COCOA.

Cracked cocoa (cocoa nibs) makes a most useful drink for diabetic patients. This is not generally appreciated by the profession.

The sample of cracked cocoa (cocoa nibs) used has been purchased of the S. S. Pierce Co., Boston. It was analyzed by Professor Street, with the following result:

Moisture	2.83
Protein	14.69
Fat	51.42
Fiber	4.32
Ash	3.88
Starch	7.48
Reducing sugar, as dextrose, direct	none
Reducing sugar, as dextrose, after inversion	0.94

The cocoa is prepared for the table by adding a cupful of the cracked cocoa to a quart of water and letting it simmer on the back of the stove all day, adding water from time to time.

Professor Street was good enough to analyze the infusion, and wrote me: "The cocoa prepared according to directions contained 0.032 per cent. of reducing sugar as dextrose direct and 0.138 per cent. of total reducing sugars."

Cocoa shells may be prepared in the same way, but 1 to $1\frac{1}{2}$ cups will be required to one quart of water A mixture of equal parts cracked cocoa and cocoa shell may also be used.

The cracked cocoa should be strained before serving, otherwise the cocoa nibs might be eaten and the carbohydrate in these would not be negligible.

AGAR-AGAR JELLY.

One-eighth to one-quarter of an ounce is sufficient to make one quart of jelly. The agar-agar is added to the boiling water. After it is thoroughly dissolved and cooking completed, flavoring extract, coloring matter and saccharin are added as desired. Agar-agar may also be added to broths.

Miss E. Grace McCullough, Dietitian at the Peter Bent Brigham Hospital, has given me several practical suggestions about the preparation of hospital diabetic diets. Many of these have been incorporated in what follows.

THRICE COOKED VEGETABLES.

The vegetables are cleaned, cut up fine, soaked in cold water and then strained. The vegetables are then tied up loosely in a large square of double cheesecloth—large enough so that the corners of the cloth, after it has been tied up with a string, make conveniently long ends, and also large enough to allow the vegetables to swell without sticking together. They are then transferred to fresh cold water, placed on the fire and brought to the boiling-point, at which temperature they are maintained for from three to five minutes. This water is then poured off and replaced by fresh, and the vegetables again boiled a similar length of time. Three changes of water are usually sufficient to remove the carbohydrate, as has been proved by Professor Wardall's preliminary experiments. The pots for the vegetables should be of sufficient size to hold a large quantity of water, and in a hospital, vegetables enough for the daily supply of six patients. Vegetables thus cooked will keep in cold storage two or more days, and reheating them in a steamer is a simple affair.

If the vegetables are cooked with the cover left off the pot they will be lighter in color and the flavor not so strong.

Miss McCullough has adopted several expedients by which variety in the 5 per cent. vegetables is obtained, and thus the monotony of the diet avoided. She suggests that the large outer stalk—slightly green covering—of cauliflower be carefully cleaned, cut into half-inch pieces and boiled until tender, and frequently this is transferred from four waters. Similarly the green outside leaves and any small pieces of lettuce may be shredded and served like spinach. Chard in season can be purchased by the bushel, cut, and then chopped up. Rhubarb retains its acid flavor and has proved so acceptable an

addition to the diet that in the future it should be canned by the cold-water method for subsequent use. The flat, large, celery stalks with any or all the leaves, whether yellow or green, chopped fine, serve excellently well. White, green and red cabbage is cut fine and served as cole-slaw.

Diabetic patients should be urged, whenever possible, to have a garden and to raise suitable vegetables for themselves for the ensuing winter. One of my patients does this and thus provides himself with the best of celery, cabbage, lettuce, etc. This patient eats a slice of cabbage cut, as one buys cheese in a grocery store, for breakfast each morning, and by this means keeps the bowels perfectly regular.

Canned vegetables which have been of the most service at the Peter Bent Brigham Hospital are of four varieties: soup asparagus, broad, flat, cut string beans, the tender, green, stringless bean and the white wax beans. The pods are separated from the beans, the latter being used for the benefit of other patients. Soup asparagus proved to be excellent for hospital use. It is a by-product of the factory and consists of the broken-off tips and the shorter, thin stalks which are unfit for the standard size. The pieces are about one inch long and are all edible.

SQUAB.

A squab when carefully boned yields 50 grams of meat. This is broiled in an oiled paper case to prevent evaporation, and when served with the escaped juices proves a favorite dish for patients. It contains about 12 grams protein and 5 grams fat.

BOILED DINNER.

Corned beef, with cabbage and one other vegetable, served together as a boiled dinner, is most acceptable to male patients. A portion containing 50 to 75 grams of meat and 100 grams of each vegetable makes an excellent meal. Corned-beef hash made of meat and vegetables in the same proportion could also be served for variety.

SEASONING.

The proper seasoning of the food is a great help to the diabetic patient. So many articles are excluded from the diet that the great variety which is possible in the preparation of the food by the help of seasoning is overlooked. Horseradish, to be sure, contains 10 per cent. of carbohydrate, but it would take at least two teaspoonfuls to contain a gram, and probably far more. Sour pickles are allowable, and other pickles made from the group of 5 per cent. vegetables, provided one is assured that they have been prepared without sweetening. Mint, capers, curry, tarragon vinegar, onion, bay leaf and cloves may all be used as seasoning; tomato stewed with onion, bay leaf and cloves, and thickened with Irish moss, may be served as a sauce.

DIABETIC MENUS.

Patients naturally differ in their likes and dislikes. Case No. 866 arranged his diet, which contained carbohydrate 39 grams, protein 84 grams and fat 81 grams essentially as shown in Table 39. Using this as a basis, Miss Alice M. Dike, of Simmons College, has arranged the following menus and appended various useful recipes:

TABLE 39.—THE DIET OF CASE NO. 866 WITH MODIFICATIONS FOR ONE WEEK.

	Amount.	Carbohydrate.	Protein.	Fat.
5 per cent. vegetables	900 gm.	30	15	0
Eggs	2	0	12	12
Bacon	30 gm.	0	5	15
Meat	180 gm.	0	48	30
20 per cent. cream	120 gm.	4	4	24
Strawberries	75 gm.	5	0	0
		39	84	81

FIRST DAY (TYPICAL).

Breakfast.

Fried eggs, 2; bacon, 30 grams.
Stewed tomato, 150 grams; string beans, 150 grams.
Coffee with cream, 30 grams.
Bran muffin.

Lunch.

Broth.
Baked haddock, 90 grams.
Boiled cabbage, 150 grams; lettuce and cucumbers, 150 grams.
Coffee jelly, cream, 30 grams.
Tea, cracked cocoa or cocoa shells, cream, 30 grams.
Bran muffin.

Dinner.

Broth.
Roast beef, 90 grams.
Asparagus, 150 grams; cold slaw, 150 grams.
Strawberries, 75 grams; cream, 30 grams.
Coffee.
Bran muffin.

SECOND DAY.

In the following menus, unless otherwise stated, one bran muffin, 40 grams of cream, and tea, coffee, cracked cocoa or cocoa shells are served at each meal. Broth may also be served. If cream is used in the preparation of any dish, or is served with it, the amount is deducted from that allowed for the day. In every case 45 grams are allowed per day for beverages.

Breakfast.

Liver, 60 grams; bacon, 15 grams.
String beans, 150 grams; spinach, 150 grams.

Lunch.

Omelet (eggs 2) with chopped ham, 30 grams.
Cabbage, 150 grams; radishes, 90 grams.
Rhubarb jelly, 60 grams.

Dinner.

Hamburg steak, 90 grams; bacon, 15 grams.
Swiss chard, 150 grams; sauerkraut, 150 grams.
Orange, 50 grams.

THIRD DAY.

Breakfast.

Eggs (1½) scrambled with tomato, 60 grams; bacon, 30 grams.
String beans, 150 grams; sliced cucumber, 90 grams.

Lunch.

Tuna fish salad [fish, 90 grams; lettuce, 30 grams; boiled dressing (cream 60 grams; egg, ½)].
Brussels sprouts, 150 grams; boiled cucumbers, 120 grams.
Peach, 37 grams.

Dinner.

Corned beef, 90 grams; cabbage, 200 grams.
Stewed rhubarb, 100 grams.
Cocoa shells jelly.

FOURTH DAY.

Breakfast.

Soft boiled egg (1); bacon, 30 grams.
Baked tomatoes, 150 grams; string beans, 150 grams.

Lunch.

Cold beef, 90 grams; grated horseradish.
String beans, 200 grams; artichoke salad, 100 grams.
Raspberries, 37 grams.

Dinner.

Chicken, 90 grams.
Stewed okra and tomato, 200 grams; celery, 100 grams.
Coffee; Spanish cream (egg, 1; cream, 30 grams).

FIFTH DAY.

Breakfast.

Orange, 50 grams.
Shirred egg (egg, 1; cream, 15 grams); bacon, 20 grams.
String beans, 150 grams; spinach, 150 grams.

Lunch.

Hash (corned beef, 90 grams; cabbage, 180 grams; leeks, 60 grams or onions, 30 grams; bacon, 10 grams).
Lettuce, 60 grams.
Coffee jelly whip (white of one egg).

Dinner.

Lamb chops, 90 grams; tomato sauce, 60 grams.
Asparagus, 120 grams; dandelion greens, 120 grams; and bacon, 10 grams.
Baked custard (yolk of 1 egg; cream, 30 grams).

SIXTH DAY.

Breakfast.

Scrambled eggs (1 and 1 egg white); dried beef, 30 grams; bacon, 30 grams.
Cauliflower, 150 grams; string beans, 150 grams.

Lunch.

Spinach soup (spinach, 60 grams; cream, 30 grams; egg yolk, 1).
Broiled finnan haddie, 60 grams.
Boiled celery, 150 grams; cabbage, 90 grams.
Coffee jelly.

Dinner.

Steak, 90 grams; water cress, 60 grams.
Summer squash or vegetable marrow, 150 grams; baked tomato, 90 grams.
Blackberries, 37 grams.

SEVENTH DAY.

Breakfast.

Scalloped fish, 90 grams; bacon, 15 grams.
String beans, 200 grams; radishes, 100 grams.

Lunch.

Egg salad (egg, 2; lettuce, 30 grams); bacon, 15 grams.
Boiled leeks, 150 grams; beet greens, 120 grams.
Irish moss blanc mange (cream, 75 grams).

Dinner.

Broiled swordfish, 90 grams.
Fried egg plant, 150 grams; tomato jelly salad (tomato, 120 grams; lettuce, 30 grams).
Blueberries, 37 grams.

PICNIC LUNCHES.

FIRST DAY.

(The amounts used must be deducted from the day's total.)

Dinner.

Cold chicken, 60 grams.
Asparagus, 200 grams; cucumber, 100 grams.
Baked custard (egg, 1; cream, 60 grams).

Supper.

Sardines, 90 grams.
Lettuce, 100 grams; ripe tomatoes, 200 grams.
Coffee jelly.

SECOND DAY.

Dinner.

Veal (60 grams) loaf with hard boiled egg (1).
Endive, 100 grams; string beans, 200 grams.
Cocoa shells jelly.

Supper.

Cold ham, 90 grams.
Asparagus, 180 grams; leek (90 grams) and lettuce (30 grams) salad.
Orange, 50 grams.

RECIPES.[1]

Meat Broth.

1 pound (3 parts lean meat and 1 part bone).
1 quart cold water.
1 teaspoonful salt.

Cut or chop the meat fine, removing all fat, add cold water and let stand one hour, heat slowly to the boiling-point, simmer four or more hours, strain, add salt, and water to make up the one quart; cool. Remove fat carefully, reheat and serve.[2]

A double boiler is convenient for cooking small quantities of broth. Sweet herbs (thyme, marjoram, summer savory), parsley, celery seed, bay leaf, peppercorns, cloves and any of the 5 per cent. vegetables may be used for seasonings. If vegetables are served in the broth the amount must be deducted from the day's allowance.

Broth may be thickened with egg yolk or Irish moss. (See Cream Soups.)

[1] See footnote page 134.

[2] For composition of soups, broths and bouillons see pages 158 and 159. Unless very thin broths or bouillons are employed an allowance for food value must be made.

Clam and Oyster Broth.

½ cup clams or oysters and their liquor.
1 cup cold water.
Celery seed, blade of mace, if liked.

Chop the carefully washed clams or oysters, add liquor and water, bring slowly to the boiling-point, strain and add salt if necessary. Cream, plain or whipped, may be added just before serving.

Cream Soups.

1 cup purée [cooked and strained vegetables, 60 to 120 grams (see below) and broth, cream or water in which vegetable was cooked to make 1 cup].
¼ teaspoonful salt.
Pepper.
1 egg yolk.

Heat the purée to the boiling-point, add slowly to the beaten egg yolk, beating constantly, add salt and serve immediately, or place in double boiler, cook one minute, stirring constantly; add salt and serve immediately. The mixture will curdle if not stirred carefully or if overcooked.

If preferred a small piece of Irish moss washed and soaked ten minutes may be cooked with the purée to thicken it in place of egg.

Asparagus, 60 grams.
Celery, 60 grams and small blade of mace.
Cauliflower, 60 grams.
Spinach, 60 grams and bit of bay leaf.
Leek, 60 grams.
Tomato, 120 grams; and bit of bay leaf, 2 cloves, ½ teaspoonful chopped chives.

Scalloped Fish.

Flake any cooked fish, moisten with broth, tomato or cream, season, place in baking dish and cover with bran muffin dried and crumbled fine. Meat, hard-boiled eggs or vegetables may be prepared in the same way.

Fried Fish.

Dry whole small fish, or pieces suitable for serving, rub with mineral oil and coat with crumbs prepared as for scalloped fish. Fry in mineral oil or bake in a hot oven. Tomato cut in thick slices may be prepared in the same way.

Eggs.

Any of the regular recipes for cooking eggs may be used if water, cream, tomato or broth is used in place of milk and the butter is omitted or mineral oil substituted for it.

French Dressing.

½ teaspoonful salt.
Pepper.
1 teaspoonful vinegar.
1 tablespoonful mineral oil.

Mix in the order given, chill and beat or shake in a stoppered bottle until thick. Serve immediately.

Boiled Dressing.

½ teaspoonful salt.
Pepper.
1 egg or 2 egg yolks.
¾ cup cream or cream and water.
2 tablespoonfuls vinegar.

Mixed in the order given, adding the vinegar slowly to the other ingredients, cook over hot water until thickened, stirring all the time; chill, strain and serve.

Tomato Jelly Salad.

The proportions given are for use with granulated gelatin; if powdered gelatin is used a little more may be required.

2 teaspoonfuls gelatin.
2 tablespoonfuls cold water.
¼ teaspoonful salt.
240 grams stewed and strained tomato.

Soak the gelatin in the cold water ten minutes, dissolve in the hot tomato, season, mold and chill. A bit of bay leaf, two cloves and a slice of leek, or a few chopped chives, may be stewed with the tomato.

Cucumber, Radish or Celery Jelly Salad.

2 teaspoonfuls gelatin.
2 tablespoonfuls cold water.
2 tablespoonfuls vinegar and water or both to make 1 cup.
¼ teaspoonful salt.
60 grams or more chopped vegetable.

Mix like tomato jelly salad, adding the vegetable just before pouring into the mold. Chopped mint may be used in place of vegetable.

Horseradish Sauce.

2 teaspoonfuls grated horseradish
½ teaspoonful vinegar.
⅛ teaspoonful salt.
Cayenne.
1 tablespoonful cream.

Mix the first four ingredients and add to the cream beaten stiff. Serve immediately.

It is unfortunate that horseradish is occasionally adulterated with a 10 per cent. vegetable—turnip.

Cucumber Sauce.

Grate 60 grams cucumber, drain and season with salt, pepper and vinegar.

Tomato Sauce.

Stew 60 grams of tomato with salt, pepper, cloves, bay leaf and chives. Strain. Irish moss may be cooked with tomato for thickening.

Mint Sauce.

2 tablespoonfuls finely chopped mint leaves.
¼ cup vinegar.
Saccharin.

Pour vinegar on the mint and let stand thirty minutes, add saccharin and serve.

Jellies.

The following jellies are made by dissolving 2 teaspoonfuls gelatin soaked in 2 tablespoonfuls cold water in any of the liquids given below which should be boiling hot when measured and added; stir well, add saccharin to taste and flavoring, strain and chill.

Liquid.
1 cup coffee.
1 cup cracked cocoa or cocoa shells infusion.
120 grams stewed and strained rhubarb or cranberries, water to fill cup.
120 grams cream, water to fill cup.
1 cup water.

Any fruit extract, grated rind of orange or lemon, dry or green ginger root, not crystallized ginger, or mint leaves boiled in water to taste, mint or wintergreen extract.
2–4 drops almond extract.
¼ teaspoonful vanilla extract.

Custard.

1 cup cream and water.
1 egg or 2 egg yolks.
Salt.
Saccharin.
¼ teaspoonful vanilla.

Heat the liquid and add slowly to the slightly beaten egg, stirring constantly. For soft-boiled custard, place in a double boiler, cook until it coats the spoon, remove and chill promptly. When cool strain and flavor. For baked custard mix all the ingredients, pour into custard cups and bake in a moderate oven until jelly-like. Chill and serve.

Spanish Cream.

1 teaspoonful gelatin.
1 tablespoonful cold water.
6 tablespoonfuls hot coffee and cream or water and cream.
1 egg yolk.
Saccharin.
Salt.
1 egg white.

Soak gelatin in cold water, dissolve in hot liquid, pour mixture on egg yolk and cook like soft-boiled custard, add saccharin and salt, and pour while still hot on the stiffly beaten white of egg, beating constantly, mold and chill.

Irish Moss Blanc Mange.

1 cup cream and water.
1 heaping tablespoonful Irish moss.
Salt.
⅛ teaspoonful vanilla.

Soak the moss ten minutes in cold water, drain, add to milk and cook until a drop jellies on a cold plate, add salt and vanilla, strain, mold and chill.

Ice-cream.

Any of the liquids suggested under jellies may be frozen for ice-cream.

CHAPTER XVIII.

DIET TABLES.

The improvement in the treatment of diabetes owes much to the recent dissemination of knowledge regarding the composition of foods. To the United States Government we are indebted for an excellent monograph by Atwater and Bryant entitled "The Chemical Composition of American Food Materials," Bulletin No. 28, revised edition, which was first issued in 1906. This can be purchased by sending ten cents in coin to the Superintendent of Documents, Washington, D. C. From this have been abstracted such analyses as are especially useful in the diets of both normal and diabetic individuals and have computed the calories per 100 grams instead of recording the same per pound.

Analyses are also inserted published by the Connecticut Agricultural Experiment Station. Most of these analyses are concerned with the so-called diabetic foods, but in some cases other analyses are included as well.[1] To these latter lists the value of protein and fat have been added. Whereas the analyses of many so-called diabetic foods are recorded, no special food is recommended. In general the cost of these spe-

[1] "In using the tables of the Connecticut Agricultural Experiment Station it should be understood that the percentages in the protein column are uniformly calculated from the nitrogen found, using the conventional factor 6.25. With pure wheat products the factor 5.7 gives more accurate results, and, strictly speaking, the latter factor should be used for gluten flours and other gluten products. In baked products where the protein may be derived from other sources than wheat, such as soya beans, cotton seed, nuts, etc., it is impracticable to vary the factor with each particular food without causing endless confusion. Similarly, it has seemed to the analysts best to retain for the flours the old factor for the sake of uniformity. In the high-grade ground glutens, containing as much as 13.7 per cent. of nitrogen, the use of the proper factor would reduce the protein by about 7.5 per cent., and the nitrogen-free extract would be increased in the same proportion. The terms "nitrogen-free extract" and "carbohydrates" are used synonymously, but the explanation of nitrogen-free extract in the preceding paragraph should be borne in mind. The values given for starch, however, are absolute, being direct determinations and having no connections with the protein factor used. A 0 means no starch was found, but a blank space does not mean the same, indicating merely that starch was not tested for."

cial foods is greater than that of the common foods selected from the ordinary diet; in fact, the patient pays for the taste.

The analyses which follow apply to the *edible* portion of the food in question. The appearance of a blank in a table does not indicate that the particular ingredient is missing. Whenever a range in composition occurs in the tables the same applies to carbohydrate alone.

VEGETABLES: FRESH.

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Caloric value per 100 grams.
Lettuce	1.2	0.3	2.2	17
Cucumbers	0.8	0.2	2.3	15
Spinach	2.1	0.3	2.3	21
Asparagus	1.8	0.2	2.4	19
Rhubarb	0.6	0.7	2.5	19
Endive	1.0	0.0	2.6	15
Vegetable marrow	0.1	0.2	2.6	13
Sorrel	.	..	3.0	12
Sauerkraut	1.7	0.5	3.0	24
Beet greens, cooked	2.2	3.4	3.2	54
Celery	1.1	0.1	3.3	18
Tomatoes	0.9	0.4	3.3	21
Brussels sprouts	1.5	0.1	3.4	21
Watercress	0.7	0.5	3.7	23
Sea-kale	1.4	0.0	3.8	21
Okra	1.6	0.2	4.0	25
Cauliflower	1.8	0.5	4.3	30
Egg plant	1.2	0.3	4.3	25
Cabbage (range 3.0– 6.5)	1.6	0.3	4.7	29
Radishes (range 2.7– 7.5)	1.3	0.1	5.0	27
Leeks	1.0	0.4	6.0	32
Mushrooms[1] (range 2.0–18.0)	3.5	0.4	6.0	43
Pumpkins (range 3.0–14.0)	1.0	0.1	6.0	30
String beans (range 3.9–10.0)	2.3	0.3	6.0	37
Turnips (range 2.3–18.0)	1.3	0.2	6.0	32
Celery root	2.0	0.4	6.3	26
Kohl-rabi (range 3.5–14.0)	2.0	0.1	7.0	38
Oyster plant	1.2	0.1	7.0	35
Rutabagas (range 3.0–12.0)	1.3	0.2	7.0	36
Truffles	9.1	0.5	7.0	71
Squash (range 3.0–15.0)	1.4	0.5	8.0	43
Beets (range 6.0–10.0)	1.6	0.1	9.0	44
Carrots (range 5.9–11.5)	1.1	0.4	9.0	45
Onions (range 4.0–14.0)	1.6	0.3	9.0	46
Parsnips (range 6.0–14.0)	1.6	0.5	11.0	56
Chicory	..	..	15.0	62

[1] The protein and carbohydrate in these are to a considerable extent unassimilable, and patients often eat these with impunity, as I have found since my attention was called to this fact by Professor Wardall.

VEGETABLES: FRESH—Continued.

		Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Caloric value per 100 grams.
Peas		7.0	0.5	15.0	95
Artichokes[1]		2.6	0.2	16.0	78
Yams[2]		..	..	16.0	66
Corn		3.1	1.1	19.0	101
Potatoes	(range 13.0–27.0)	2.2	1.1	20.0	101
Lima beans		7.1	0.7	22.0	126
Sweet potatoes	(range 16.5–44.5)	1.8	0.1	26.0	120
Soy beans[2]	(range 19.3–39.0)	20.0	4.3	28.0	

VEGETABLES: CANNED.

Beans, haricot-verts		1.1	0.1	2.0	14
Asparagus	(range 1.6– 3.3)	1.5	0.1	2.3	26
Brussels sprouts		1.5	0.1	2.9	19
Okra		0.7	0.1	2.9	16
Tomatoes	(range 1.0– 4.5)	1.2	0.2	3.0	19
String beans	(range 1.5– 4.5)	1.1	0.1	3.3	19
Macedoine, mixed vegetables	(range 1.9– 5.0)	1.4	0.0	3.9	22
Artichokes	(range 3.2– 6.1)	0.8	0.0	4.4	21
Pumpkins	(range 3.6– 7.3)	0.8	0.2	6.0	30
Peas	(range 4.3–17.2)	3.6	0.2	10.0	58
Squash	(range 3.6–12.8)	0.9	0.5	10.0	49
Beans, haricot-flageolets	(range 9.8–12.4)	4.6	0.1	11.0	65
Lima beans	(range 9.6–16.5)	4.0	0.3	13.0	72
Baked beans		6.9	2.5	17.0	121
Red kidney beans		7.0	0.2	17.0	100
Corn	(range 11.7–25.1)	2.8	1.2	18.0	97
Succotash	(range 13.9–21.3)	3.6	1.0	18.0	98

VEGETABLES: DRIED.

Beans	22.5	1.8	55.0	334
Cow peas	21.4	1.4	55.0	326
Peas	24.6	1.0	58.0	348
Lentils	25.7	1.0	59.0	357
Lima beans	18.1	1.5	66.0	359

BERRIES AND FRUITS: FRESH.

Strawberries	1.0	0.6	5.0	30
Grape fruit	..	..	6.0	25
Alligator pear	..	..	7.0	29
Lemons	1.0	0.9	7.0	31
Watermelons	0.3	0.1	7.0	32
Blackberries	1.3	1.0	8.0	56
Cranberries	0.4	0.6	8.0	41
Peaches	0.5	0.2	9.0	41
Muskmelons	0.7	0.3	10.0	47
Raspberries	1.7	1.0	10.0	45

[1] French artichokes. According to König, canned artichokes contain 92.46 per cent. water, 0.79 per cent. protein, 0.02 per cent. fat, 4.43 per cent. carbohydrates.

[2] Sorrel, chickory and yams also contain protein and fat.

[3] The carbohydrate is non-assimilable.

BERRIES AND FRUITS: FRESH—Continued.

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Calorie value per 100 grams.
Whortleberries	0.7	3.0	10.0	72
Apples	0.4	0.5	11.0[1]	71
Pears	0.4	0.6	11.0	72
Apricots	1.1	?	12.0	54
Gooseberries	0.4	..	12.0	51
Mulberries	0.3	..	12.0	48
Pineapples	0.4	0.3	12.0	54
Currants	0.4	..	13.0	55
Oranges	0.8	0.2	13.0	63
Mangoes	..	..	13.0	53
Grapes	1.3	1.6	15.0	75
Nectarines	0.6	?	15.0	64
Cherries	0.8	0.8	17.0	80
Figs	1.5	..	17.0	76
Huckleberries	0.6	0.6	17.0	78
Plums	1.0	..	17.0	74
Pomegranates	1.5	1.6	17.0	91
Prunes	0.8	?	19.0	81
Bananas	1.5	0.7	20.0	95
Bananas, red	1.2	0.7	17.5	81
Persimmons	0.8	0.7	32.0	141
Dates	1.9	Trace	54.0	229
ORANGES.[2]				
Florida, average of seven analyses (soluble portion)			8.0	33
California, average of eight analyses (soluble portion)			8.3	34
GRAPE FRUIT.[2]				
Porto Rico, average of two analyses (soluble portion)			8.2	34
California, average of four analyses (soluble portion)			6.9	28
Florida, average of four analyses (soluble portion)			6.6	27
FRUITS: CANNED.				
Peaches	0.7	0.1	11.0	49
Blueberries	0.6	0.6	13.0	61
Pineapples (range 6.0–25.0)	0.4	0.7	15.0	70
Apricots	0.9	?	17.0	73
Pears	0.3	0.3	18.0	78
Cherries	1.1	0.1	21.0	92
Crab apples	0.3	2.4	54.0	245
Blackberries	0.8	2.1	56.0	252

Jams, jellies, preserves and marmalade contain 47 per cent. or more carbohydrate. There is a wide variation in the sugar content of canned fruits. Pie peaches are packed in water while other grades may be found in 30, 40 or even 50 per cent. syrup.

[1] Variation in carbohydrate 9.0 to 21.0 per cent.

[2] If carbohydrate in peeled oranges is reckoned at 10 per cent., comparatively little error will result. Analyses of oranges and grape fruit made for me by E. M. Frankel, Ph.D.

FRUITS: DRIED.

Contain 63 per cent. or more of carbohydrate.

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Caloric value per 100 grams.
PICKLES AND CONDIMENTS.				
Distilled vinegar	0	0	0	0
Cider vinegar[1]	0	0	0.25	1
Cucumber pickles	0.5	0.3	2.7	16
Capers	3.2	0.5	5.0	41
Prepared mustard	4.7	4.1	5.0	78
Prepared mustard plus cereal (range 4.0–15.0)	3.5	1.9	7.0	61
Ketchup (range 3.0–26.0)	1.8	0.2	10.0	50
Spiced salad vinegar	..	..	10.0	41
Horseradish	1.4	0.2	11.0	53
Chili sauce (range 14.0–28.0)	..	..	20.0	82
Spiced pickles	0.4	0.1	21.0	89
Olives, green[2]	2.1	12.9	1.8	137
Olives, ripe	2.0	21.0	4.0	220
Peppers (paprica), green, dried	15.5	8.5	63.0	400
NUTS.				
Filberts	15.6	65.3	13.0	724
Hickory nuts	15.4	67.4	11.4	736
Peanuts	25.8	38.6	24.4	563
Pecans	11.0	71.2	13.3	760
Pine nuts; pignolias	33.9	49.4	6.9	626
Pistachios, first quality, shelled	22.3	54.0	16.3	659
Walnuts, California	18.4	64.4	13.0	726
Walnuts, California, black	27.6	56.3	11.7	683
Walnuts, California, soft shell	16.6	63.4	16.1	723
Almonds	21.0	54.9	17.3	667
Brazil	17.0	66.8	7.0	364
Butternuts	27.9	61.2	3.5	95
Chestnuts, fresh	6.2	5.4	42.1	248
Chestnuts, dried	10.7	7.0	71.5	392
Cocoanuts	5.7	50.6	27.9	607

[1] Professor Street writes (November 27, 1916): "In our last examination of 27 brands we found the reducing sugars to range from 0.27 to 1.52 per cent."

[2] Univ. Calif. College Agriculture, 1916. Personal communication.

Dairy Products, etc.

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Caloric value per 100 grams.
Milk, whole	3.3	4.0	5.0	72
Milk, condensed, sweetened	8.8	8.3	54.1	334
Milk, condensed, unsweetened, "evaporated cream"	9.6	9.3	11.2	172
Milk, skimmed	3.4	0.3	5.1	37
Cream, approximately 20 per cent. fat	2.3[1]	18.5	4.5	194
Cream, 40 per cent. fat	1.5[1]	40.0	3.0	378
Buttermilk	3.0	0.5	4.8	36
Whey	1.0	0.3	5.0	27
Kephir	3.1	2.0	1.6	38
Koumiss	2.8	2.0	5.4	53
Cheese, cottage	17.6	2.4	1.4	98

Milk Powders.

		Protein.	Fat.	CHO.	Calories per 100 grams.
1909	Trumilk	25.7	27.3	37.2	497
1913	Klim	36.3	2.2	50.5	367
1918	Mammala	25.8	14.5	49.9	433
1919	Krystalak	35.4	3.2	48.2	363
1918	Lactora	32.5	2.6	48.5	347

Cheese.

		Protein.	Fat.	Undetermined (chiefly ash).
1913	Casino Camembert	19.7	25.7	5.8
1913	Maclaren's Nippy Cheese	26.9	38.6	5.2
1913	Sap Sago Swiss Spalty	52.8	2.8	12.1
1913	Isigny Type Cheese	21.9	9.9	5.3
1913	Le Delicieux Camembert	18.4	26.5	4.4
1913	Shefford Snappy Cheese	26.3	39.4	3.4
1913	Star Brand Cream Cheese	12.7	47.3	2.0
1913	International Welsh Rarebit	25.0	35.3	5.1
1913	Liederkranz Cheese	16.3	26.4	3.2
1913	Maclaren's Deviled Cheese	25.6	33.8	5.0
1913	Cow Brand Cheese	19.1	31.9	2.3

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Caloric value per 100 grams.
Cheese, American, pale	28.8	35.9	0.3	452
" American, red	29.6	38.3	?	476
" Camembert	21.0	21.7	?	290
" Cottage	20.9	1.0	4.3	112
" Dutch	37.1	17.7	?	316
" Full cream	25.9	33.7	2.4	429
" Limburger	23.0	29.4	0.4	369
" Neufchatel	18.7	27.4	1.5	337
" Pineapple	29.9	38.9	2.6	494
" Roquefort	22.6	29.5	1.8	374
" Skimmed milk	31.5	16.4	2.2	290
" Swiss	27.6	34.9	1.3	442

[1] Estimated.—E. P. J.

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Calorie value per 100 grams.
Oils and Fats.				
Butter	1.0	85.0	..	793
Oleomargarine	0.8	92.4	..	835
Nut margarine	0.9	87.1	..	788
Lard, tallow, cod-liver oil, olive oil, peanut oil and other edible fats as Wesson Oil, Mazola, Vegetable, Kuxit, etc.	..	85 to 100	..	800–900
Meat.				
Beef, cooked:				
Roast	22.3	28.6	..	356
Round steak, fat removed	27.6	7.7	..	185
Calf's foot jelly	4.3	0.0	17.0	87
Beef, canned:				
Dried beef	39.2	5.4	..	211
Beef, corned and pickled:				
Corned beef, all analyses	15.6	26.2	..	307
Mutton, cooked:				
Mutton, leg roast	25.0	22.6	..	312
Pork, pickled, salted and smoked:				
Ham, smoked, lean	19.8	20.8	..	274
Bacon, smoked, all analyses	10.5	64.8	..	645
Sausage, A:				
Bologna sausage (range 0.2– 3.1)	18.7	17.6	0.6	243
Frankfort (range 0.0– 6.6)	19.6	18.6	1.1	258
Pork (range carbohydrate 0.0–8.6)	13.0	44.2	1.1	468
Deerfoot Farm, cooked, analysis furnished by the manufacturers	19.93	54.21	0.34	587
Poultry and game, fresh:				
Chicken, broilers	21.5	2.5	..	111
Fowls	19.3	16.3	..	230
Goose, young	16.3	36.2	..	403
Turkey	21.1	22.9	..	299
Liver:				
Beef	21.0	4.5	1.7	133
Chicken, as purchased	22.4	4.2	2.4	141
Goose, as purchased	16.6	15.9	3.7	231
Mutton, as purchased	23.1	9.0	5.0	199
Pork, as purchased	21.3	4.5	1.4	135
Turkey, as purchased	22.9	5.2	0.6	144
Veal, as purchased	19.0	5.3	..	127
Tripe, canned	16.8	8.5	..	147
Fish: Fresh.				
Cod sections	16.7	0.3	..	72
Flounder, whole	14.2	0.6	..	64
Haddock, entrails removed	17.2	0.3	..	74
Halibut, steaks or sections	18.6	5.2	..	124
Mackerel, whole	18.7	7.1	..	142
Salmon, whole	22.0	12.8	..	209
Shad, whole	18.8	9.5	..	165
Trout (brook), whole	19.2	2.1	..	98

	Protein, per cent.	Fat, per cent.	Carbohydrates, per cent.	Caloric value per 100 grams.
Fish: Preserved and Canned.				
Cod, salt, "boneless"	27.3	0.3	..	108
Herring, smoked	36.9	15.8	..	298
Sardines, canned	23.0	19.7	..	277
Shad roe	20.9	3.8	2.6	121
Sturgeon caviare	30.0	19.7	8.0	198
Shell-fish.				
Clams, long, in shell	8.6	1.0	2.0	53
Crabs, hardshell, whole	16.6	2.0	1.2	91
Lobster, whole	16.4	1.8	0.4	86
Mussels, in shell	8.7	1.1	4.1	63
Oysters, in shell	6.2	1.2	3.7	52
Scallops, as purchased	14.8	0.1	3.4	76
Terrapin	21.2	3.5	..	120
Turtle, green, whole	19.8	0.5	.	86
Gelatin.				
Gelatin[1]	91.4	0.1	..	375
Eggs.				
Eggs, edible portion:[2]				
Hens', uncooked	13.4	10.5	..	158
Hens', boiled	13.2	12.0	..	168
Hens', boiled whites	12.3	0.2	..	55
Hens', boiled yolks	15.7	33.3	..	376
Soups: Home-made				
Beef	4.4	0.4	1.1	26
Bean	3.2	1.4	9.4	65
Chicken	10.5	0.8	2.4	61
Clam chowder	1.8	0.8	6.7	43
Meat stew	4.6	4.3	5.5	81
Soups: Canned.				
Bouillon	2.2	0.1	0.2	11
Chicken gumbo	3.8	0.9	4.7	43
Chicken soup	3.6	0.1	1.5	22
Consomme	2.5	..	0.4	12
Julienne	2.7	..	0.5	13
Mock turtle	5.2	0.9	2.8	41
Mulligatawny	3.7	0.1	5.7	40
Oxtail	4.0	1.3	4.3	46
Pea soup	3.6	0.7	7.6	52
Tomato soup	1.8	1.1	5.6	41
Vegetable	2.9	..	0.5	14

[1] Many of the brands of commercial gelatin are said to contain from 83 to 87 per cent. gelatin, 11 to 14 per cent. moisture and 1 to 2 per cent. of ash.—E. P. J.

[2] One egg contains approximately protein 6 grams and fat 6 grams, of which one-half the protein and all the fat are in the yolk.—E. P. J.

CANNED BOUILLONS.

	Protein.	Fat.	Salt.
Acker, Merrall and Condit	2.0	0.1	1.4
Schimmell's	0.8	0.1	2.3
Campbell's	1.3	0.1	1.8
Curtice Bros. Blue Label	2.1	0.2	0.9
Franco-American	1.6	0.1	0.9
Mohican	0.5	0.1	2.5

BOUILLON CUBES.

	Sodium chloride, per cent.
Armour's Beef Extract and Vegetable Tablets	21.00
Mason's Beef Tea Lozenges	2.24
Anker's Bouillon Capsules	30.00
Steero Bouillon Cubes	59.48
Knerr's Consomme	61.46
O. X. O. Bouillon Cubes	62.70
Vegex Cubes	57.02

FLOUR, MEALS, BREAD, PASTRY, ETC.

	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Caloric value per 100 grams.
Flours, meals, etc.:				
Barley meal and flour	10.5	2.2	72.8	361
Buckwheat flour	6.4	1.2	77.9	356
Cornmeal, unbolted	8.4	4.7	74.0	381
Hominy	8.3	0.6	79.0	363
Oatmeal	16.1	7.2	67.5	409
Rolled oats	16.7	7.3	66.2	407
Rice	8.0	0.3	79.0	359
Rice, boiled	2.8	0.1	24.4	112
Rye flour	6.8	0.9	78.7	359
Wheat flour, California fine	7.9	1.4	76.4	358
Wheat flour, entire wheat	13.8	1.9	71.9	369
Wheat flour, patent roller process, high grade (average of all analyses of high medium grades and grade not indicated)	11.4	1.0	75.1	363
Wheat preparations:				
"Shredded Wheat Biscuit"[1]	8.3	0.6	76.0	351
"Wheatena"	11.3	2.8	76.0	384
"Cream of Wheat"	11.5	0.9	75.0	353
Cracked wheat	11.1	1.7	74.0	365
"Wheatlet"	12.8	1.6	74.0	371
"Quaker Wheat Berries"	13.8	1.9	72.0	370
Macaroni	13.4	0.9	74.1	366
Macaroni, cooked	3.0	1.5	15.8	91
Soy bean meal	42.5	19.9	34.0[2]	499
Pea flour	25.7	1.8	57.0	354
Acorn meal	7.3	4.9	64.0	338

[1] Weight of 1 biscuit 30 grams, and it contains, approximately, carbohydrate 23 grams and protein 3 grams.

[2] The assimilable carbohydrate in soy beans is 3 per cent. or less.

FLOUR, MEALS, BREAD, PASTRY, ETC.—Continued.

	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Caloric value per 100 grams.
Graham flour	13.3	2.2	70.0	362
Pop corn, popped	10.7	5.0	77.0	586
Cassava meal	1.3	1.2	81.0	348
Potato starch	0.9	0.1	81.0	337
Sago starch	2.2	0.0	81.0	341
Tapioca (arrow-root)	0.1	0.1	84.0	346
Banana flour	3.9	1.0	85.0	375
Corn starch	1.2	0.0	85.0	353
Rye	10.2	1.7	72.0	353
Buckwheat	10.1	2.5	61.0	315
"Ralston Health Food"	11.9	1.7	72.0	360
"Force"	10.6	1.1	74.0	358
"Pettijohn's Breakfast Food"	9.1	2.0	74.0	359
"Malt Breakfast Food"	13.8	1.5	75.0	378
"Triscuit"	11.0	1.4	75.0	365
"Grape Nuts"	11.5	0.6	75.0	360
Farina	11.0	1.4	75.0	367
"Mapl-Flake"	11.0	1.4	76.0	369
Hominy	7.6	0.2	78.0	353
Puffed rice	6.7	0.4	80.0	359
Toasted corn flakes	..	..	81.0	332

		Protein, per cent.	Fat, per cent.	Carbohydrate[2] per cent.	Starch, per cent.	Caloric value per 100 grams.
[1]1913	Glidine: Menley & James, New York	91.4	0.8	1.0	0	377
1909	Plasmon: Plasmon Co., London	78.7	2.7	0.0	..	339
1915	Cotton-seed flour: Allison, Schulenburg Oil Mill, Schulenburg, Texas	50.4	11.2	..	1.1	348

WHEAT BRAN.

		Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.
1914	Ballard's Obelisk Sanitary Edible Bran	17.3	5.4	55.7
1917	Culp's Capitol Health Bran	13.4	4.3	57.6
1914	Health Food Co.'s Wheat Bran	14.3	4.1	56.2
1914	Jireh Wheat Bran	16.8	4.8	56.7
1914	Johnson's Educator Wheat Bran	15.4	4.7	54.4
1914	Kellogg's Sterilized Wheat Bran	16.3	5.2	54.4

[1] Analysis of preparation manufactured at this date.

[2] For interpretation of "carbohydrate" see footnote page 151.

WHEAT BRAN—Continued.

	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Caloric value per 100 grams.
Bread:[1]				
Bread, brown	5.4	1.8	47.1	231
Bread, corn (Johnnycake)	7.9	4.7	46.3	265
Bread, rye	9.0	0.6	53.2	260
Graham bread	8.9	1.8	52.1	266
Rolls, French	8.5	2.5	55.7	286
Rolls, all analyses	8.9	4.1	56.7	307
Toasted bread	11.5	1.6	61.2	312
White bread, home-made	9.1	1.6	53.3	270
White bread, miscellaneous	9.3	1.2	52.7	266
Whole wheat bread	9.7	0.9	49.0	249
Whole rye bread	11.9	0.6	35.0	198
Peanut bread	33.6	12.8	20.0	339
Acorn bread	..	..	27.0	111
Cassava bread	..	..	27.0	111
Alfalfa bread	10.6	1.3	64.0	318
Crackers:				
Boston (split) crackers	11.0	8.5	71.1	415
Uneeda Biscuit[2]	10.1	8.8	70.0	399
Graham crackers	10.0	9.4	73.8	430
Pilot bread	11.1	5.0	74.2	396
Saltines	10.6	12.7	68.5	441
Zwieback	9.8	9.9	73.5	433
Peanut zwieback	23.2	8.0	28.0	284
Doughnuts (range 45.0–63.0)	6.7	21.0	52.0	436
Cake (except fruit cake) (range 53.0–78.0)	6.3	9.0	63.0	368
Jumbles (range 52.0–71.0)	7.4	13.5	63.0	418
Fruit cake	5.0	10.9	64.0	384
Macaroons (range 57.0–70.0)	6.5	15.2	64.0	430
Pie:				
Apple	3.1	9.8	42.8	279
Custard	4.2	6.3	26.1	183
Squash	4.4	8.4	21.7	185
Mince (range 30.0–44.0)	5.8	12.3	38.0	194
PASTES.				
Noodles	13.3	0.8	72.0	357
Vermicelli	10.9	2.0	72.0	358
Spaghetti	12.1	0.4	74.0	353

[1] Recent analyses by Street have shown that the method generally used for determining fat in bread gives too low results. In fourteen samples the average fat by the usual method was 0.59 per cent. while by an improved method it was 1.95 per cent.

[2] Analysis from Conn. Exp. Sta. Report, 1914, p. 230. One biscuit weighs 7 grams and contains about 5 grams carbohydrate, 0.7 gram protein and 0.5 gram fat.

Miscellaneous.	Carbohydrate, per cent.
Plain chocolate	25.0
Cocoa nibs, roasted	28.0
Baking powder	(range 0–51.5) 32.0
Cocoa	38.0
Milk chocolate	51.0
Milk cocoa	52.0
Custard powders	59.0
Sweet chocolate	67.0

Non-alcoholic Beverages.	Carbohydrate, per cent.
Tea (0.5 oz. to 1 pt. water)	0.6
Coffee (1 oz. to 1 pt. water)	0.7
Cocoa (0.5 oz. to 1 pt. water)	1.1
Cider	(range 0–13.5) 4.5
Cocoa (0.5 oz. to 1 pt. milk)	6.0
Cream or lemon soda	7.0
Sarsaparilla	7.0
Birch beer	8.0
Ginger ale	8.0
Root beer	9.0

Near Beers.	Total reducing sugars.
Anzac	5.4
Bevo	5.8
Wesco	4.2
Pablo	4.8

	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Caloric value per 100 grams.
Chocolate[1]	12.9	48.7	30.3	629
Cocoa[1]	21.6	28.9	37.7	510
Cereal coffee infusion (1 part boiled in 20 parts water)	0.2	..	1.4	7

Coffee Substitutes.[2]

	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Caffein, per cent.
Drinket	5.69	0.03	81.85	...	None
Old Grist Mill	15.13	3.87	58.91	30.38	0.17
Jaffee	11.00	1.66	62.72	16.40	None
Postum Cereal	12.38	3.30	59.71	19.20	None
Calumet Cereal	13.06	4.44	63.06	37.97	0.08
Barley Coffee	10.81	2.73	72.12	42.80	None

[1] Analyses of food and not of beverages or infusion.
[2] Analyses by John Phillips Street.

	So-called Diabetic Preparations.[1]	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Calculated calories per 100 grams.
	Flours and Meals.					
1910	Acme Mills Co., Portland, Ore. .	9.4	1.9	77.4	71.4	364
	Herman Barker, Somerville, Mass.:					
1912	Barker's Gluten Food, "A" .	86.9	0.5	4.6	trace .	370
1913	Barker's Gluten Food, "B" .	85.1	0.6	7.2	3.7	375
1913	Barker's Gluten Food, "C" .	84.1	0.6	8.6	3.4	377
1914	Battle Creek Sanitarium Co., Battle Creek, Mich., 80 per cent. Gluten Meal . . .	84.0	..	..	5.8	368
	Callard, Stewart & Watt, London:					
1909	Casoid Flour	82.5	1.6	3.1	0	357
	Cereo Co., Tappan, N. Y.:					
1913	Soy Bean Gruel Flour . . .	43.1	21.4	24.9	trace	465
	Christian's Natural Food Co., Kenilworth, N. J.:					
	Christian's Imported Protoid Nuts	37.6	48.2	5.7	trace	607
	Farwell & Rhines, Watertown, N. Y.:					
1913	Gluten Flour	43.1	1.2	46.6	38.1	370
1913	Gluten Flour	46.3	1.1	42.9	32.8	367
1913	Cresco Flour	18.1	1.0	67.4	57.2	351
1913	Special Dietetic Food . . .	27.5	2.8	56.6	40.0	362
1913	Golden Rod Milling Co., Portland, Ore., Acme Special Flour .	15.8	1.4	71.4	57.9	361
1913	O. B. Gilman, Boston, Mass.:					
	Gluten Flour	47.3	2.0	40.4	31.4	369
1913	Health Food Co., New York:					
	Almond Meal	50.3	14.8	17.9	trace	406
1914	Almond Meal	49.1	21.8	15.9	0	457
1911	C B X Cold Blast Flour, 25 per cent. protein	10.1	0.9	79.6	68.9	367
1913	Pronireu (Griddle-cake Flour) .	37.3	1.2	47.3	37.7	349
1913	Glutosac Gluten Flour . . .	39.9	2.3	47.5	36.9	370
1914	Gluten Flour No. 1	75.7	0.9	12.8	7.1	362
1914	Pure Washed Gluten . . .	85.6	1.0	5.4	2.8	373
1913	Pure Washed Gluten Flour .	80.3	1.6	11.1	7.0	380
1914	Protosac Gluten Flour . . .	45.9	2.0	42.3	31.5	370
1914	Protosoy Soy Flour	42.9	19.2	26.0	1.9	448
1906	Jireh Diabetic Food Co., New York:					
1906	Diabetic Flour	14.3	2.2	71.9	66.6[2]	365

[1] See footnote page 151 for method employed in calculating carbohydrate at Conn. Agricultural Experiment Station. By this method of calculation the carbohydrate in various preparations, such as those made from casein, may appear too high or even present in small quantities when it is actually absent. The carbohydrate in preparations made from soy beans is unassimilable and therefore harmless.

[2] Determined by the diastase method, without previous washing with water, and calculated as starch.

	So-called Diabetic Preparations.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Calculated calories per 100 grams.
	Flours and Meals.—Continued.					
1913	Patent Cotton Seed Flour	49.1	12.7	21.3	6.0	396
1913	Patent Lentils Flour	27.3	1.2	59.8	42.6	359
1913	Protein Flour	31.4	2.0	56.7	48.5	370
1913	Soja Bean Flour	42.3	18.2	25.8	0.0	435
	Johnson Educator Food Co., Boston, Mass.:					
1911	Educator Standard Gluten Flour	40.1	1.4	50.2	40.9	374
	The Kellogg Food Co., Battle Creek, Mich.:					
	Kellogg's					
1916	20 per cent. Gluten Meal	27.06	0.02	63.03	51.24	
1916	40 per cent. Gluten Flour	36.88	1.43	52.10	48.04	
1916	40 per cent. Gluten Meal	45.56	1.11	44.57	36.50	
1916	Pure Gluten Meal	84.19	0.81	9.36	6.77	
1916	Pure Gluten Biscuit	81.00	0.83	7.71	4.02	
1916	40 per cent. Gluten Biscuit	45.13	0.98	48.83	36.98	
	Lister Bros., New York:					
1915	Diabetic Flour	84.5	3.6	..	0	372
1916	Loeb's Genuine Gluten Bread	35.40	0.17	34.99	26.37	
1916	Gluten Luft Bread	44.50	9.78	37.29	29.93	
1916	Pure Gluten Flour	47.81	1.01	41.69	35.78	
1916	Diabetic Bread Sticks	46.31	0.29	42.19	35.02	
1916	Gluten Noodles	45.19	1.03	43.69	33.19	
1916	Diabetic Sponge Cookies	44.63	37.17	8.66	1.91	
1916	Diabetic Almond Macaroons	34.25	45.01	10.46	trace	
1916	Diabetic Butter Cookies	39.31	14.93	37.25	32.18	
1916	" " "	31.38	22.29	37.05	30.66	
1916	Diabetic Lady Fingers	48.00	32.79	9.71	2.14	
1916	Gluten Cracker Meal	42.63	8.92	38.97	31.59	
1916	Gluten Almond Zwieback	44.00	6.10	39.56	33.10	
1916	Gluten Zwieback	45.44	2.39	41.06	35.72	
	Thos. Martindale & Co., Phila.:					
1913	Special Gluten Flour	40.3	1.5	49.1	41.4	371
	Mayflower Mills, Ft. Wayne, Ind.:					
1913	Bond's Diabetic Flour	40.2	1.3	48.3	40.6	366
	Theo. Metcalf Co., Boston, Mass.:					
1913	Soja Bean Meal, 18 per cent. starch	41.0	20.0	25.0	..	444
1913	Vegetable Gluten, 8.1 per cent. starch	80.4	1.5	9.8	5.9	374
	Pieser Livingston Co., Chicago:					
1913	Gluten Flour	43.3	1.3	46.2	38.4	370
	Pure Gluten Food Co., New York:					
1911	Gum Gluten Flour	38.3	1.6	50.8	42.4	371
1914	Flour, 50 per cent.	49.7	1.2	41.5	37.1	375
1914	Flour, Ground	41.9	0.9	48.1	42.6	369

	So-called Diabetic Preparations.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Calculated calories per 100 grams.
	Flours and Meals.—Continued.					
1914	Self-raising Flour	42.7	0.8	45.0	39.0	357
1914	Special Flour	90.7	0.7	1.7	2.2	376
	Sprague, Warner & Co., Chicago:					
1913	Richelieu Gluten Flour	47.7	1.2	39.7	31.6	368
	G. Van Abbott & Sons, London:					
1913	Almond Flour	24.6	58.6	7.9	0.0	657
1913	Gluten Flour	75.1	0.9	12.6	12.4	359
	Wilson Bros., Rochester, N. Y.:					
1913	Gluten Flour, $\frac{1}{7}$ Standard	20.8	2.1	64.6	54.6	361
1913	Self-raising, $\frac{1}{7}$ Standard	17.4	2.0	63.5	51.8	342
1913	Waukesha Health Products Co., Waukesha, Wisc.: Hepco Flour	42.9	20.8	22.3[1]	trace	448
	Breakfast Foods.					
	Brusson Jeune Villemur, France:					
1913	Farine au Gluten	33.9	0.6	53.8	48.8	356
1910	Gluten Semolina	17.2	0.5	71.6	64.9	360
	Farwell & Rhines, Watertown, N. Y.:					
1913	Barley Crystals	11.5	1.3	75.2	62.7	359
1913	Cresco Grits	17.8	1.4	68.6	54.1	358
1908	Hazard's Wheat Protein Breakfast Food	40.1	1.0	49.7	?	368
	Health Food Co., New York:					
1913	Manana	37.6	1.9	46.8	31.0	355
	Pure Gluten Food Co., New York:					
1914	Gum Gluten Breakfast Food	45.4	0.9	46.4	39.2	375
1914	Gum Gluten Granules	42.7	0.7	48.8	41.9	372
1901	Pure Gluten Breakfast Cereal	43.7	1.6	44.4	?	367
	Waukesha Health Products Co., Waukesha, Wisc.: Hepco Grits[2]					
	Macaroni, Noodles, etc.					
	Brusson Jeune, Villemur, France:					
1910	Pâtes aux Oeufs Macaroni	13.9	0.4	76.2	69.2	364
1910	Pâtes aux Oeufs Nouillettes	14.4	0.5	75.7	68.9	365
1913	Petites Pâtes au Gluten	18.6	1.0	70.4	61.2	365
1910	Vermicelle au Gluten	18.4	0.4	72.4	65.8	367
	Jireh Diabetic Food Co., New York:					
1913	Macaroni	16.9	0.9	71.4	58.8	361

[1] Chiefly derived from Soy bean and therefore non-assimilable, and for patients can be considered carbohydrate-free.

[2] Said to be identical with Hepco Dodgers.

	So-called Diabetic Preparations.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Calculated calories per 100 grams.
	Macaroni, Noodles, etc.—Continued.					
1913	Loeb's Diabetic Bakery, New York: Home-made Noodles	41.8	5.5	41.7	36.7	384
1914	Pure Gluten Food Co., New York: Gum Gluten Noodles	40.5	1.2	49.1	41.8	369
1913	Gustav Müller & Co., New York: Dr. Bouma Sugar-free Fat-milk[1]	2.4	5.3	..	..	57
1913	D. Whiting & Sons, Boston: Sugar-free Milk (ave. 3 analyses)	5.7	7.2	trace	..	88
1914	Sugar-free Milk	6.4	9.3	0.2	..	110
	Soft Breads.					
1914	Health Food Co.: Protosac Bread	29.8	1.8	35.2	27.7	276
1914	Glutosac Bread	27.2	2.1	31.1	22.2	252
1914	J. Heinbockel & Co., Baltimore, Md.: Diabetic Bread for Diabetes	8.6	1.5	52.1	40.4	256
1913	Loeb's Diabetic Bakery, New York: P. & L. Genuine Gluten Bread	10.4	2.6	53.7	44.2	280
1914	P. & L. Genuine Glubetic Bread	38.8	4.1	25.7	19.2	294
1915	Lister Bros., New York: Casein Bread	36.6	18.4	..	0	322
	Hard Breads and Bakery Products.[2]					
1909	Callard, Stewart & Watt, London: Almond Biscuit, plain	28.3	28.0	36.8	..	512
1909	Almond Shortbreads	19.5	52.1	27.0	..	630
1913	Casoid Biscuits, No. 1	66.8	18.8	5.8	4.0	460
1909	Casoid Biscuits, No. 2	57.8	25.5	5.6	0.0	483
1909	Casoid Biscuits, No. 3	54.3	25.0	7.8	trace	473
1909	Casoid Dinner Rolls	78.0	11.1	2.1	..	420
1909	Casoid Lunch Biscuit	25.5	44.9	21.6	..	593
1909	Casoid Rusks	37.0	32.3	20.8	..	522
1909	Cocoanut Biscuit—Saccharin	16.6	61.3	16.4	..	684
1909	Ginger Biscuit—Saccharin	17.1	58.6	18.1	..	668
1913	Kalari Batons	43.2	39.0	7.4	0	553
1909	Kalari Biscuits	56.9	31.4	1.7	..	517
1909	Prolactic Biscuit	42.9	27.5	19.3	..	496
1913	Charrasse Biscuits Croquettes au Gluten	34.3	5.4	52.3	30.6	395
1913	Biscottes Lucullus	11.4	5.7	73.4	59.2	391
1913	Gluten Exquis Biscuits aux Amandes	18.1	23.8	50.6	25.5	489

[1] Water, 91.8 per cent. [2] See footnotes, pages 151 and 163.

	So-called Diabetic Preparations.	Protein per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Calculated calories per 100 grams.
	Hard Breads, etc.—Continued.					
1913	Gluten Fleur de Neige Pain	35.9	12.5	42.8	25.1	427
1913	Mignonettes au Gluten	40.1	5.7	43.6	27.3	386
1913	Pain de Gluten	40.8	5.3	43.5	27.2	385
1913	Tranches Grillées pour Potage	40.6	3.6	45.5	28.8	377
	Health Food Co., New York:					
1913	Alpha Best Diabetic Wafer	66.1	13.6	11.3	trace	432
1914	Alpha Best Diabetic Wafer	67.1	8.4	11.7	1.3	391
1913	Diabetic Biscuit	25.0	9.2	54.2	46.5	400
1914	Diabetic Biscuit	35.9	8.8	46.5	39.8	409
1906	Glutona	22.1	11.8	58.5	54.9[1]	429
1906	Glutosac Rusks	36.5	3.8	51.6	42.5[1]	387
1906	Wafers, Plain	29.4	9.6	49.9	41.6[1]	404
1906	Salvia Sticks	39.2	20.8	24.0	18.7[1]	440
1914	Gluten Nuggets	31.7	14.3	45.7	34.9	438
1914	Gluten Butter Wafers	31.1	13.9	47.0	38.9	438
1914	Gluten Rusks	39.3	3.4	47.0	33.6	376
1914	Gluten Wafers, Plain	42.6	1.7	44.3	29.6	363
	Gluten Zwieback	36.4	7.7	46.6	32.5	401
1914	No. 1 Proto Puffs	72.3	2.8	13.0	9.2	366
1914	No. 2 Proto Puffs	58.8	2.1	27.0	20.7	362
1914	Protosac Rusks	39.7	3.0	46.7	35.9	373
1914	Protosoy Diabetic Wafers	37.1	23.5	29.3	14.4	477
1914	Salvia Almond Sticks	22.3	29.9	41.0	28.3	523
	Heinz Food Co., Chicago:					
1913	Gluten Biscuits	12.8	18.3	57.7	21.4	447
	Heudebert, Paris:					
1914	Pain d'Aleurone pour Diabétiques	76.1	1.5	9.2	4.2	354
1914	Pain de Gluten pour Diabétiques	80.7	0.8	6.5	3.4	356
1914	Pain de "Essential" en Biscottes	26.4	1.2	62.2	49.9	365
1914	Hoyt's Gum Gluten Biscuit Crisps	52.7	0.5	38.0	31.2	368
1916	Huntley & Palmer, Reading, England:					
	Akoll Biscuits	53.6	28.3	6.2	trace	494
	Johnson Educator Food Co., Boston:					
1913	Educator Gluten Bread Sticks	35.9	7.2	45.8	37.5	392
1911	Gluten Cookies	26.4	16.0	49.8	37.8	449
	The Kellogg Food Co., Battle Creek, Mich.:					
1912	Avena-Gluten Biscuit	21.4	12.7	55.5	41.1	422
1913	Potato Gluten Biscuit	41.5	0.5	48.0	39.5	363
1909	Pure Gluten Biscuit	48.3	3.3	39.1	..	379

[1] Determined by the diastase method, without previous washing with water, and calculated as starch.

	So-called Diabetic Preparations.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Starch, per cent.	Calculated calories per 100 grams.
	Hard Breads, etc.—Continued.					
1913	Taro-Gluten Biscuit	31.3	0.5	57.7	48.2	361
1913	40 per cent. Gluten Biscuit	37.2	0.8	53.2	45.0	369
1912	80 per cent. Gluten Biscuit	82.4	0.9	4.4	4.7	355
	Loeb's Diabetic Bakery, New York:					
1913	Gluten Luft Bread	27.9	9.2	54.2	44.1	411
1914	Gluten Luft Bread	52.4	13.2	26.0	22.9	433
1914	Chocolate Almond Bars	16.3	41.0	31.8	5.7	561
1914	Diabetic Almond Macaroons	46.5	37.7	8.0	0.6	558
1914	Diabetic Bread Sticks	50.4	3.4	34.5	24.6	371
1914	Diabetic Chocolates	14.9	51.4	23.0	6.9	614
1914	Diabetic Lady Fingers	56.6	28.3	6.0	1.8	505
1914	Diabetic Sponge Cookies	54.7	30.1	5.0	1.2	510
	Pure Gluten Food Co., New York:					
1913	Gum Gluten Biscuit Crisps	42.9	0.7	48.5	39.3	372
1914	No. 1 Dainty Fluffs	79.9	0.5	11.3	10.7	370
1914	No. 2 Dainty Fluffs	66.3	0.5	24.9	21.9	369
	G. Van Abbott & Sons, London:					
1913	Caraway Biscuits for Diabetics	35.6	37.5	15.9	8.6	544
1913	Diabetic Rusks for Diabetics	70.9	0.8	16.0	12.6	355
1913	Euthenia Biscuits	35.8	40.7	13.2	6.9	562
1913	Gluten Biscottes or Rolls	51.6	2.3	33.0	29.8	359
1913	Gluten Bread or Slices	54.1	2.2	30.9	27.4	361
1913	Gluten Butter Biscuits for Diabetics	44.1	33.2	12.7	9.0	526
1913	Ginger Biscuits for Diabetics	34.6	39.4	16.7	10.9	560
1913	Midolia Biscuits	17.6	36.4	31.6	13.4	524
1913	Walnut Biscuits for Diabetics	20.9	57.2	12.3	trace	648
	Waukesha Health Products Co., Waukesha, Wis.:					
1913	Hepco Dodgers.	41.6	21.3	20.7	trace	441
	Callard, Stewart & Watt, London					
1913	Casoid Chocolate Almonds	22.3	51.8	16.1	trace	620

Wines:[1] Dry.

		Grams reducing sugars, per 100 c.c.
California, red, Bordeaux or Claret	(range 0.04– 0.63)	0.16
" " Burgundy	(range 0.03– 0.42)	0.15
" " Zinfandel	(range 0.03– 0.35)	0.15
" white, Rhine	(range 0.06– 0.63)	0.15
" " Burgundy	(range 0.10– 0.45)	0.23
" " Sauterne	(range 0.07– 3.57)	0.64
French, red	(range 0.11– 0.84)	0.23
" white	(range 0.65– 1.02)	0.84

[1] Natural wines contain from 6 to 12 per cent. of alcohol; "fortified" wines, such as port, sherry, madeira and marsala (and certain champagnes), contain from 15 to 20 per cent.

Wines: Dry.—Continued.		Grams reducing sugars, per 100 c.c.
German, white	(range 0.09– 1.96)	0.20
Hungarian, white	(range 0.04– 0.86)	0.25
Italian, red	(range 0.02– 2.70)	0.16
" white	(range 0.02– 2.15)	0.19
North Carolina	(range 0.08– 1.75)	0.49
Ohio	(range 0.07– 1.54)	0.31
Portuguese, red	(range 0.01– 1.21)	0.16
" white	(range 0.10– 1.19)	0.32
Rhine, red	(range 0.06– 0.27)	0.13
" white	(range 0.02– 1.02)	0.18
Spanish, red	(range 0.19– 0.54)	0.35
" white	(range 0.27– 0.62)	0.42
Sparkling, French and German	(range 0.13– 1.95)	0.53
Swiss, red	(range 0.10– 0.27)	0.13
" white	(range 0.08– 0.38)	0.10
Virginia	(range 0.06– 1.23)	0.16

Wines: Sweet.		
California Port	(range 0.23–13.56)	4.76
" Madeira and Sherry	(range 0.12–17.21)	5.38
French	(range 0.73–12.40)	5.38
German	(range 0.64–12.13)	4.60
Madeira	(range 2.48– 3.88)	2.95
Malaga	(range 12.50–25.20)	18.32
Marsala	(range 2.67– 8.24)	3.25
Port	(range 3.76– 8.17)	6.04
Rhine	(range 1.82–10.69)	6.35
Sherry	(range 0.52– 4.80)	2.54
Sparkling, American	(range 6.51–12.02)	8.28
" French and German	(range 8.00–18.50)	10.92
Tokay, true	(range 1.86–20.50)	12.62
" commercial	(range 2.70–40.70)	19.80
Vermouth	(range 3.47–14.39)	9.46

Other Alcoholic Beverages.	Carbohydrates, per cent.
Brandy, gin, rum, whisky	0
Absinth	Trace
Angostura	4.2
Beer	4.5
Weiss bier	4.6
Ale	5.1
Porter or Stout	7.0
Malt extract, commercial	10.6
Curaçao	25.5
Crême de menthe	27.7
Kümmel	31.2
Benedictine	32.6
Anisette	34.4
Chartreuse	34.4
Maraschino	52.3
Malt extract, true	71.3

CHAPTER XIX.

SELECTED LABORATORY TESTS USEFUL IN MODERN DIABETIC TREATMENT.

EXAMINATION OF THE URINE, BLOOD AND EXPIRED AIR.

An early diagnosis in diabetes is as important as in tuberculosis. The disease usually begins insidiously and its prompt detection depends upon the routine examination of the urine of all patients rather than upon the examination of the urines of patients who present symptoms of the disease. General practitioners should teach their patients, as a matter of routine, to have their own urines and the urines of the members of their families examined each birthday. This is not fantastic; it is simply a part of the movement to have each member of the community undergo a physical examination each year.

EXAMINATION OF THE URINE.

Examination of the urine should cost the patient little. Formerly many deprecated the routine examinations made in drug stores, but the value of such examination is now recognized. The druggist is a trained chemist. He is constantly doing quantitative work, and it is far easier and cheaper for him to examine a urine than for a doctor. Druggists will undoubtedly undertake such work with satisfaction. It will be an agreeable relief from the many activities of a drug store which have nothing to do with the profession of a pharmacologist.

The examination of the urine of the diabetic patient is usually a simple matter. It comprises a statement indicating the volume in twenty-four hours, specific gravity, reaction,

presence or absence of albumin, sugar and diacetic acid. Frequently the ammonia, salt (sodium chloride), acetone and nitrogen are determined and the urinary sediment submitted to microscope study.

Although diabetic patients can test their own urines for sugar and almost invariably are warranted in relying upon the result of their examination, they should not feel that they are expert analysts. More than once patients have arrived at erroneous conclusions, in part due to the preparation of chemical reagents employed. It is therefore safer for all diabetic patients to send their urines once a month to their physician, for the simple tests for volume, color, reaction, specific gravity, albumin and sugar. Such an examination can be made by a physician within fifteen minutes. A quantitative examination for sugar would require of an individual, not daily accustomed to it not far from half an hour or more.

The Collection of the Twenty-four Hour Quantity of Urine.—To collect the twenty-four hour quantity of urine, discard that voided at 7 A.M. and then save in a cool place all urine passed thereafter up to and including that obtained at 7 A. M. the next morning.

Reaction.—The normal urine is acid. Urine voided after a meal rich in vegetables and fruits is frequently alkaline, due to the alkaline salts which they contain. Therefore the report that the urine is acid does not imply in the slightest degree that a patient has acid poisoning. (For detection of acid poisoning, see Tests for Diacetic Acid and Ammonia, pp. 181 and 182.)

Specific Gravity.—The specific gravity of the urine will be best understood if it is recalled that the specific gravity of water is considered to be 1000. Normal urine has a specific gravity, on account of the solids contained in it, of about 1015 to 1020. Normal urine if concentrated would have a higher specific gravity, and if dilute it would be lower. The specific gravity of the urine in diabetes varies chiefly with the percentage of sugar which it contains. It frequently is above 1020 and may be above 1040, but sugar may be present in the urine when the specific gravity is as low as 1007.

Albumin.—Two tests are usually employed, the one in confirmation of the other.

1. *Nitric Acid Test.*—To 5 c.c. of filtered urine add one-third the quantity of nitric acid by pouring it down the side of the glass so that it underlies the urine. A white precipitate forms in the urine at the junction of the two fluids. A precipitate higher in the urine may be due to urates. Bile or urinary coloring matters may give a color to the urine or precipitate at the junction of the fluids.

2. *Heat Test.*—Pour 10 c.c. of filtered urine into a test-tube and boil the upper half of the fluid. Add five drops of 10 per cent. of acetic acid and boil again. A precipitate appearing on boiling which persists after the addition of the acid, or appearing on the second boiling, is albumin; one disappearing with the acid is phosphates. The test may fail with an excess of acid.

Sugar.—Sugar is absent from the urine of carefully treated diabetics. If present it can be readily demonstrated if it amounts to as little as 0.05 per cent., and it may rise to as high as 9 or 10 per cent. when the diabetic diet is not followed. Most untreated cases show between 2 and 6 per cent. of sugar. The total quantity of sugar in the urine in the twenty-four hours is easily estimated by multiplying the percentage of sugar which the urine contains by the total amount of urine voided. Thus, if the total quantity of urine is 3 liters (3000 c.c., a little more than 3 quarts, which would equal 2838 c.c.), and the percentage of sugar is 4, the amount of sugar in the urine would be (3000×0.04) 120 grams, that is, about 4 ounces or $\frac{1}{4}$ pound. It is not very often that one finds more than 1 pound of sugar excreted in the urine during twenty-four hours. The food value of the sugar lost, if only 120 grams, is considerable. Each gram of sugar is the equivalent of 4 calories, and the total would amount to 480 calories in a day, which is approximately one-fourth of the total food value required by an individual, with a quiet occupation, who weighs 60 kilograms (132 pounds). Thus it is evident that 4 untreated diabetics, even though the disease is of very moderate severity, provided they eat enough to make up the loss, will waste in a day enough food to supply

the needs of a normal individual of equal weight for the same space of time.

Tests of Sugar.—*Qualitative Tests.*—Many tests for sugar in the urine are employed. At present I use the Benedict test[1] most. The Benedict solution employed has the advantage of not decomposing even after months. Druggists occasionally find difficulty in making it, and on many occasions my patients have been sold unreliable solutions. The qualitative Benedict solution is made as follows:

	Grams or c.c.
Copper sulphate (pure crystallized)	17.3
Sodium or potassium citrate	173.0
Sodium carbonate (crystallized) (one-half the weight of the anhydrous salt may be used)	200.0
Distilled water to make	1000.0

The citrate and carbonate are dissolved together (with the aid of heat) in about 700 c.c. of water. The mixture is then poured (through a filter if necessary) into a larger beaker or casserole. The copper sulphate (which should be dissolved separately in about 100 c.c. of water) is then poured slowly into the first solution, with constant stirring. The mixture is then cooled and diluted to one liter. This solution keeps indefinitely.

Case No. 632 has written out the rules for the test, with his customary military directness and precision:

Benedict's solution is used for testing the urine for sugar as follows: To about 5 c.c. (one large teaspoonful) of the solution add 8 drops of urine; the test may then be continued in either of the two following ways:

1. Boil the mixture of the solution and urine for three minutes and set aside to cool to the temperature of the room.

2. Place the tube containing the mixture of the solution and urine in bubbling, boiling water, where it must remain, with the water actually boiling, for five minutes.

In either case if the solution remains clear the urine being tested is sugar-free; if one can read print through the solution the percentage of sugar is so slight that it can be disregarded; if a heavy greenish precipitate forms it usually

[1] Benedict, S. R.: Jour. Am. Med. Assn., 1911, lvii, p. 1193.

means there is a trace of sugar; the appearance of a yellow sediment indicates the presence of a few tenths per cent. of sugar in the urine, and a red sediment more.

Upon removal from the boiling water shake the test-tube. The discoloration which occasionally forms upon the surface is unimportant and with shaking disappears.

Benedict's original description of the test is as follows: Five cubic centimeters, a trifle over one teaspoonful, of the Benedict solution, are placed in a test-tube and 8 to 10 drops (not more) of the urine to be examined are added. The mixture is then heated to vigorous boiling, kept at this temperature for three minutes, and allowed to cool spontaneously. In the presence of glucose the entire body of the solution will be filled with a precipitate, which may be greenish, yellow or red in tinge according to whether the amount of sugar is slight or considerable. If the quantity of glucose be low (under 0.3 per cent.) the precipitate forms only on cooling. If no sugar be present, the solution either remains perfectly clear or shows a faint turbidity that is blue in color, and consists of precipitated urates. The chief points to be remembered in the use of the reagent are (1) the addition of a small quantity of urine (8 to 10 drops) to 5 c.c. of the reagent, this being desired not because larger amounts of normal urine would cause reduction of the reagent, but because more delicate results are obtained by this procedure; (2) vigorous boiling of the solution after addition of the urine, and then allowing the mixture to cool spontaneously, and (3) if sugar be present the solution (either before or after cooling) will be filled from top to bottom with a precipitate, so that the mixture becomes opaque.

Benedict (personal communication) states that the test as performed above will detect glucose in as low concentration as 0.01 to 0.02 per cent. provided the urine is of low dilution.

Fehling's Test.—The solutions required are made up as follows: Dissolve 34.64 gm. pure $CuSO_4$ in water and make up to 500 c.c. Dissolve 173 gm. Rochelle salt and 60 gm. sodium hydrate each in 200 c.c. water and mix, and then make up also to 500 c.c.; 5 c.c. of each solution are used for the test.

In performing the test, 3 to 5 c.c. of equal quantities of the

copper solution and the alkaline solution are mixed in a test-tube and thoroughly boiled. If no reduction takes place one-half as much urine as the reagent employed is then added and the whole boiled vigorously again. A yellow or red precipitate indicates the presence of sugar; a greenish precipitate may or may not indicate sugar. Occasionally substances in the urine other than sugar reduce the copper upon prolonged boiling, but this is so exceptional that I consider it far safer to boil the solution a second time, and when in doubt, to repeat the test without boiling.

Quantitative Tests.—All quantitative tests for glucose in the urine are as unsatisfactory as the qualitative tests are satisfactory. It is one of the chief advantages of modern treatment that the need for these tests is nearly abolished. It will be one of the disadvantages of modern treatment if we introduce a multiplicity of new tests in diabetes. The simplification of the treatment of diabetes means everything to the practitioner and patient. The simplest quantitative test for sugar for physicians who do not devote unusual attention to diabetes is the fermentation test.

Fermentation Test.—To 100 c.c. of urine of known specific gravity, one-fourth of a fresh yeast cake, thoroughly broken up, is added and the whole is set away at a temperature of 85° to 95° F. Twenty-four hours later the urine is tested with Fehling's or Benedict's solutions. If a reduction is obtained it is set aside for further fermentation. Complete fermentation having been proved, the specific gravity is taken after the urine has acquired its original (room) temperature. The difference in specific gravity multiplied by 0.23 gives the percentage. In the performance of the fermentation test for sugar a few crystals of tartaric acid should be added whenever the urine is alkaline. If the temperature of the urine (room) is 76° F. when the specific gravity is taken at the beginning and end of the test the result will be still more accurate.

Benedict's Test.—The easiest method with which I am acquainted for performing the quantitative Benedict test is that employed by Miss Evelyn Warren, my former assistant.

Quantitative Benedict Solution.—The quantitative Benedict solution is different from the qualitative. Mistakes often occur from this solution being used for the qualitative test

Fig. 14.—Apparatus required for a simplified, quantitative Benedict test.

for sugar, for which purpose it is valueless. The rule for the quantitative Benedict solution is given on (page 178).

Articles Required.

Ten cubic centimeter pipette graduated; small white enamelware dish, 3 inches across, 2 inches deep; sodium carbonate; water and flame.

The test can be performed by the aid of a kitchen gas burner or small alcohol stove. If the gas burner is not a small one and so flares up around the edges of the dish, put an asbestos plate or simply an iron cover over it.

Performance of Test.

1. Place 5 c.c. of the quantitative Benedict solution in the dish.
2. Add less than one-fourth teaspoonful of sodium carbonate.
3. Add about 10 c.c. water.
4. Dilute 1 part urine with 9 parts of water unless the quantity of sugar is low. (A low percentage of sugar is shown by the qualitative Benedict test turning green instead of yellow. With small quantities of sugar it is unnecessary to dilute the urine.)
5. Bring the contents of the dish to boiling, maintain in this condition and then add, drop by drop, the urine from the graduated pipette until the blue color has entirely disappeared. Upon the first trial too much may be added, and therefore, having noted the approximate quantity of urine required to reach the end-point, invariably repeat the test as a control.

Calculation.

Five cubic centimeters of the Benedict quantitative copper solution are reduced by 0.01 gram glucose. Consequently, the quantity of undiluted urine required to reduce the 5 c.c. Benedict solution contains 0.01 gram glucose.

$$\frac{\frac{0.01}{x}}{12} \times 100 = \text{per cent.} \qquad x = \text{c.c. of undiluted urine.}$$

Example.—Fifteen hundred cubic centimeters urine in twenty-four hours. Five cubic centimeters used to reduce (decolorize) the Benedict solution.

$$\frac{0.01}{5} \times 100 = 0.2 \text{ per cent.}$$

1500 × 0.002 (0.2 per cent.) = 3 grams sugar in twenty-four hours.

Example.—If the urine had been diluted with 9 parts water —in other words, 10 times—the calculation would be:

5 c.c. diluted urine = 0.5 c.c. actual urine.

$$\frac{0.01}{0.5} \times 100 = 2 \text{ per cent.}$$

1500 × 0.02 (2 per cent.) = 30 grams sugar in twenty-four hours.

For convenience in the laboratory, instead of working out the percentages of sugar in the urine by the above formula, we use the accompanying scale, shown in Table 40.

The method as originally described by Benedict[1] is as follows: "Like Fehling's quantitative process the method is based on the fact that in alkaline solution a given quantity of glucose reduces a definite amount of copper, thus decolorizing a certain amount of copper solution. The copper is, however, precipitated as cuprous sulphocyanate, a snow-white compound, which is an aid to accurate observation of the disappearance of the last trace of color. The solution for quantitative work, which keeps indefinitely, has the following composition:

Pure crystallized copper sulphate, 18 grams.

Crystallized sodium carbonate, 200 grams (or 100 grams of the anhydrous salt).

Sodium or potassium citrate, 200 grams.

Potassium sulphocyanide, 125 grams.

Five per cent. potassium ferrocyanide solution, 5 c.c.

Distilled water to make a total volume of 1000 c.c."

[1] Benedict, S. R.: Loc cit., p. 173.

TABLE 40.—PERCENTAGE OF SUGAR BY BENEDICT METHOD.

Urine, c.c. used.	Sugar, per cent.	Urine, c.c. used.	Sugar, per cent.
0.1	10.0	3.5	0.29
0.2	5.0	3.6	0.28
0.3	3.3	3.7	0.27
0.4	2.5	3.8	0.26
0.5	2.0	3.9	0.26
0.6	1.7	4.0	0.25
0.7	1.4	4.1	0.24
0.8	1.3	4.2	0.24
0.9	1.1	4.3	0.23
1.0	1.0	4.4	0.23
1.1	0.91	4.5	0.22
1.2	0.83	4.6	0.22
1.3	0.77	4.7	0.21
1.4	0.71	4.8	0.21
1.5	0.67	4.9	0.20
1.6	0.63	5.0	0.20
1.7	0.58	5.1	0.20
1.8	0.55	5.2	0.19
1.9	0.53	5.3	0.19
2.0	0.50	5.4	0.19
2.1	0.48	5.5	0.18
2.2	0.45	5.6	0.18
2.3	0.43	5.7	0.18
2.4	0.42	5.8	0.17
2.5	0.40	5.9	0.17
2.6	0.38	6.0	0.17
2.7	0.37	6.1– 6.4	0.16
2.8	0.36	6.5– 6.9	0.15
2.9	0.34	7.0– 7.4	0.14
3.0	0.33	7.5– 7.9	0.13
3.1	0.32	8.0– 8.7	0.12
3.2	0.31	8.8– 9.5	0.11
3.3	0.30	9.6–10.0	0.10
3.4	0.29		

"With the aid of heat dissolve the carbonate, citrate and sulphocyanide in enough water to make about 800 c.c. of the mixture and filter if necessary. Dissolve the copper sulphate separately in about 100 c.c. of water and pour the solution into the other liquid, with constant stirring. Add the ferrocyanide solution, cool and dilute to exactly one liter. Of the various constituents the copper salt only need be weighed with exactness. Twenty-five cubic centimeters of the reagent are reduced by 50 mg. (0.050 gram) of glucose."

The procedure for the estimation is as follows: "The urine, 10 c.c. of which should be diluted with water to 100 c.c.

(unless the sugar content is believed to be low), is poured into a 50 c.c. burette up to the zero mark. Twenty-five cubic centimeters of the reagent are measured with a pipette into a porcelain evaporating dish (10 to 15 cm. in diameter), 10 to 20 grams of crystallized sodium carbonate (or one-half the weight of the anhydrous salt) are added together with a small quantity of powdered pumice stone or talcum, and the mixture heated to boiling over a free flame until the carbonate has entirely dissolved. The diluted urine is now run in from the burette, rather rapidly, until a chalk-like precipitate forms and the blue color of the mixture begins to lessen perceptibly, after which the solution from the burette must be run in, a few drops at a time, until the disappearance of the last trace of blue color which marks the end-point. The solution must be kept vigorously boiling throughout the entire titration."

If the mixture becomes too concentrated during the process, water may be added from time to time to replace the volume lost by evaporation; however, too much emphasis cannot be placed upon the fact that the solution should never be diluted before or during the process to more than the original 25 c.c. Moreover, it will be found that in titrating concentrated urines, or urines with small amounts of sugar, a muddy brown or greenish color appears and obscures the end-point entirely. Should this be the case the addition of about 10 grams of calcium carbonate does away with this difficulty. The calculation of the percentage of sugar in the original sample of urine is very simple. The 25 c.c. of copper solution are reduced by exactly 0.050 gram of glucose. Therefore the volume of diluted urine drawn out of the burette to effect the reduction contains 50 mg. of sugar.

When the urine is diluted 1 to 10, as in the usual titration of diabetic urines, the formula for calculating the percentage of sugar is the following:

$\frac{0.050}{x} \times 1000 =$ percentage in the original sample, wherein x is the number of cubic centimeters of the diluted urine required to reduce 25 c.c. of the copper solution.

"In the use of this method chloroform must not be present

during the titration. If used as a preservative in the urine it may be removed by boiling a sample for a few minutes, and then diluting to the original volume."

Methods for the Determination of the Urinary Acids.—**Qualitative Tests.**—*Diacetic Acid* (CH_3COCH_2COOH).—The simplest method for the detection of acidosis by urinary examination is Gerhardt's ferric chloride reaction for diacetic acid. The test may be performed as follows: To about 10 c.c. of the fresh urine carefully add a few drops of an undiluted aqueous solution of ferric chloride, Liquor Ferri Chloridi, U. S. P. A precipitate of ferric phosphate first forms, but upon the addition of a few more drops is dissolved. The depth of the Burgundy red color obtained is an index to the quantity of diacetic acid present. I record the intensity of the reaction as follows: +, ++, +++ or ++++.

Confusion as to the significance of the test arises if the patient is taking sodium salicylate, aspirin or allied products. This is to a considerable extent avoided by vigorously boiling the urine after the addition of the ferric chloride, when the deep color markedly decreases or disappears if caused by diacetic acid, but remains the same if caused by the above drugs.

Acetone (CH_3COCH_3).—The different tests for acetone are in reality tests for diacetic acid. Legal's test is as follows: A few crystals of sodium nitroprusside are dissolved in 5 c.c. of urine, which is then rendered alkaline with sodium hydrate. Shake vigorously. Two drops of glacial acetic acid are then allowed to run down the side of the test-tube and a distinct purple color appears, which is best seen in the foam.

Quantitative Tests.—*Ammonia.*—The quantity of the alkali —ammonia—in the urine is a measure of the effort of the body to counteract the acid poisoning which may be present.

To this extent its estimation gives a more accurate idea of the acid production of the body than any other of the urinary tests at our disposal, which simply show the quantity of acid leaving the body. The test, however, becomes of less value as soon as extraneous alkali is administered, because under such conditions the ingested alkali is used by the body in

preference to ammonia. The normal amount of ammonia in the urine varies between 0.5 to 1 gram, and the ratio between the ammonia-nitrogen to the total nitrogen in the urine is fairly constant at 1 to 25 (4 per cent.). In severe diabetes the ammonia may gradually increase, and in Case No. 344 it amounted to 8 grams in one day.

Ronchese-Malfatti Method for the Determination of Ammonia.—(*a*) To 10 c.c. of urine in a 200 c.c. Erlenmeyer flask, add about 10 c.c. of distilled water, about 2 grams ($\frac{1}{2}$ teaspoonful) of powdered potassium oxalate and a few drops of indicator (phenolphthalein). Shake a few times to dissolve the oxalate, then titrate with one-tenth normal sodium hydroxide until the first faint pink color is permanent.

(*b*) Take 2 c.c. of commercial formalin solution in a test-tube, add a few drops of phenolphthalein indicator and then titrate with one-tenth normal sodium hydroxide until a faint pink is obtained.

(*c*) Add this neutralized formalin to the urine, which has just been titrated, and titrate again with one-tenth normal sodium hydroxide until the previous pink is again obtained.

Calculation.—The number of cubic centimeters of one-tenth normal alkali used in titration (*c*) multiplied by 0.017 gives the number of grams of ammonia in 100 c.c. of urine.

Example:—Volume of urine in twenty-four hours = 3000 c.c.
Number c.c. $\frac{N}{10}$ NaOH used is 4 c.c.
$4 \times 0.017 \times 30 = 2.04$ gm. ammonia.

No account need be taken of the amount of sodium hydroxide used in titrations (*a*) and (*b*).

The method depends upon the fact that formalin combines with free NH_3 and forms hexamethylenetetramin. The ammonia is liberated from its salts by means of NaOH.

Nitrogen.—The Kjeldahl method is that usually employed for determining the nitrogen, and a modification of it has served me well.[1] However, improvements in the method are constantly taking place, and time will always be saved by adopting the most recent methods.

[1] Joslin: The Treatment of Diabetes Mellitus, 2d edition, Lea & Febiger, 1917, p. 198.

At the present time the method in use in my laboratory is that described by Folin.[1]

Sodium Chloride.—The method employed for determining the sodium chloride is Vollard's quantitative method.

THE EXAMINATION OF THE BLOOD.

Blood Sugar.—The Lewis-Benedict method with the modification of Myers and Bailey[2] is very satisfactory. The blood-sugar method recommended by Epstein[3] also yields surprisingly good results. This is a method particularly adapted by the practising physcian, for the apparatus necessary for its performance can be readily obtained and the technic easily learned. The directions for the test come with the apparatus.[4] A series of ten consecutive determinations obtained with this method by Miss Harriet Amory is inserted, and alongside is placed for comparison the results obtained with the Lewis-Benedict method by Miss Evelyn Warren, who has had much experience with it. This method can be used by well-trained nurses.

TABLE 41.—COMPARATIVE BLOOD-SUGAR DETERMINATIONS.
(Performed by Miss Evelyn Warren and Miss Harriet Amory with the Lewis-Benedict and Epstein Methods.)

Benedict-Lewis.	Epstein.
0.23	0.25
0.19	0.24
0.10	0.15
0.34	0.34
0.20	0.23
0.22	0.22
0.23	0.26
0.09	0.12
0.21	0.24
0.10	0.10

Recently most of my analyses have been performed by the Folin and Wu[5] method. This method is rapid and especially advantageous in that the preliminary steps required for the

[1] Folin: Jour. Biol. Chem., 1919, xxxviii, p. 461.
[2] Myers and Bailey: Jour. Biol. Chem., 1916, xxiv, p. 147.
[3] Epstein: Jour. Am. Med. Assn., 1914, lxiii, p. 1667.
[4] Purchased from E. Leitz, New York.
[5] Folin and Wu: Jour. Biol. Chem., 1919, No. 1, xxxviii.

determination of the non-protein nitrogen as well as the blood sugar are identical.

EXAMINATION OF THE EXPIRED AIR FOR CARBON DIOXIDE.

A knowledge of the carbon dioxide in the alveolar air is of greatest assistance in determining the presence or absence of acid poisoning. Two methods are available, the Fridericia method and Marriott's method. Both methods are excellent, but the Marriott method is rather more practicable for the practising physician. The Fridericia apparatus can be obtained from Emil Greiner, 55 Fulton Street, New York, and the apparatus for the Marriott method, with the description of the technic for its use, from Hynson, Wescott & Co., Baltimore, Md. The alveolar air collected by the Fridericia method is of a carbon dioxide tension from 10 to 20 per cent. lower than that collected by the Marriott method.

Normally, the carbon dioxide tension of the alveolar air varies between 38 and 45 mm. mercury, 5.3 to 6.3 per cent. If abnormal acids are present in the blood, these displace a proportionate amount of carbon dioxide, and as the carbon dioxide tension in the alveolar air bears a direct relation to that in the blood, it is evident that the carbon dioxide in the alveolar air will vary likewise. A low carbon dioxide tension of the alveolar air therefore indicates an acidosis. If the carbon dioxide tension lies between 38 and 32 mm. mercury a slight acidosis is present, between 32 and 28 a moderate acidosis, and if it falls below 25 mm. mercury the acidosis is extreme. The lowest value with recovery in my group of cases has been 12 and the lowest obtained in the series was 9, and that occurred in a patient in coma.

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